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ABSTRACT

This teacher's guide is designed to provide secondary teachers with an assortment of classroom activities dealing with the Mt. St. Helens eruption of May 18, 1980, in the areas of science, social studies, math, language arts and school newspaper activities. Copy masters and teacher versions of all activities are contained within this guide, including: (1) objectives; (2) teaching suggestions; (3) answers; and (4) special directions for the procedures in the activities. These activities are designed to be used in three ways: (1) as sources for the construction of interdisciplinary units based on Mt. St. Helens; (2) as supportive materials in science curriculum; and (3) as individual activities to be used as part of existing classroom units. (CS)

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MOUNT ST. HELENS CURRICULUM MATERIALS PROJECT
EDUCATIONAL SERVICE DISTRICT 112

Project director: John Pope
August 22, 1980

DEVELOPMENT PAID FOR BY:
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*Miles from Mount St. Helens

The project director wishes to thank Roger L. Calhoun, principal of Toutle Elementary School, who originated the idea for the Mount St. Helens Curriculum Materials Project.

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SUBJECT(s)
*SCI (Science)
LA (Language Arts)
SS (Social Studies)

LEVEL(s)
**P (Primary)
I (Intermediate)
MS (Middle School)
HS (High School)

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FRONT COVER: Mount St. Helens erupts on July 22, 1980.

ALICE JACKSON/Columbian

BACK COVER: Spirit Lake lies devastated following May 18, 1980 eruption.

CHERYL HASELHORST/Columbian

INTRODUCTION

The goal of the Mount St. Helens Curriculum Materials Project is to provide teachers with classroom activities relating to the May 18, 1980, eruption. The project materials were developed between July 15 and August 19, 1980. This clearly is a dramatically short time line for a curriculum development project.

The intent has never been to present a comprehensive text on volcanism, nor has it been to prepare an introduction to geology. Rather, it is to provide high quality activities in several subject areas from which teachers can make selections for their classroom use.

We hope teachers will find these materials useful as a source of supplementary activities in the classroom. We encourage teachers to experiment with alternative ways of using the materials.

THE FORMAT:

The material is in three parts: a student tabloid containing news articles, and teacher guides at the elementary and secondary level containing activities. This unique format allows for maximum flexibility in using the 52-page student tabloid, "Mount St. Helens," and the elementary and secondary teacher's guides as a set of resources with multiple-use potential.

The 52-page student tabloid, **Mount St. Helens,** contains news articles, feature stories, editorials, diagrams and photographs dealing with the mountain and related events. The content focuses on the May 18 eruption, but other eruptions and effects are included.

The tabloid is divided into four sections.

The **Background** section offers activities dealing with volcanoes in general, the history of the mountain and other related information. The **Precursors** section deals with earthquakes, harmonic tremors, fumaroles and other events leading to the eruption. The **Eruption** section describes the May 18 eruption and immediate effects, including mudflows and ash fall. The **Effects** section of the tabloid deals with events and people such as Harry Truman, commercialization, industrial damage, medical effects and other social factors.

The two teacher's guides, **Mount St. Helens: Classroom Activities**, are designed to provide elementary and secondary teachers at all grade levels with an assortment of quality activities in the areas of science, social studies, math, language arts and newspaper in the schools. The guides contain copy masters as well as teacher versions of all activities. **IT IS RECOMMENDED TEACHERS PHOTOCOPY OR THERMOFAX ALL STUDENT ACTIVITY PAGES.** The teacher version of each activity contains objectives, teaching suggestions, answers and special directions for the procedures in the activities.

The copy masters are keyed by reference articles to the student tabloid and can be used to make photocopies, transparencies and/or ditto masters of the activity for students. Each of the five sections includes an overview of activities stating grade level and subject area. Both guides contain a summary overview before each section to aid the teacher in selecting activities.

USE OF THE MATERIAL:

These materials are designed to be used primarily in three ways. Interdisciplinary units based on Mount St. Helens can be built from several activities. A subject such as science can be supported by selected activities. Individual activities can be used as a part of existing classroom units. Teachers are encouraged to use the materials in any other way they choose.

An interdisciplinary unit involving language arts, science, social studies and math could be taught focusing on Mount St. Helens, for example. The teacher can select activities at the right level in each subject area. These activities when presented together will represent a well-balanced, educational unit. This approach will give the students a chance to experience the event from all perspectives; to know that mudflows not only raised the river's temperature and turbidity, but also destroyed homes, property and a way of life for many people. They will also discover that the eruption not only resulted in emergency shipment of filter masks, but also led to eventual changes in some people's behavior, long after ash was cleaned up.

Another possiblity is to use the activities as the basis for teaching a Mount St. Helens unit in a specific subject area such as language arts, science or social studies. In a social studies unit, students can investigate the effects of the eruption of Mount St. Helens on the lives, jobs and homes of people along the Cowiitz River. Another unit can be built to explore how newspapers are used to keep the public informed.

An individual activity can be used to support a unit. In an environmental science unit, for instance, activities that examine dissolved oxygen and total suspended solids will be very supportive. A Mount St. Helens poetry activity would be a timely part of a poetry unit.

The Language Arts: Newspaper In The Schools section contains language arts activities, several of which focus on specific parts of the newspaper. These activities can be used to teach basic language arts concepts with Mount St. Helens as the topic. Several activities are designed specifically to be used to teach the newspaper in the schools concept. In addition, some of the activities in this section can be used in other subject areas.

Teachers may use all of a given activity or just those parts most applicable. Some of the more challenging or demanding questions have been identified as extension questions or activities. These could be used as enrichment for more able students as individual projects, or as special class projects.

CAUTION: Items listed as teacher demonstrations are just that! Teacher demonstrations are dangerous and no students, under any circumstances, should be allowed to do these demonstrations. Teachers should attempt these demonstrations with the greatest of caution and only after careful preparation.

VALIDATION AND REVISION:

Due to the need to provide these materials to teachers as quickly as possible, they are being published before field testing and validation. The materials will be field tested during their first year of distribution. Revision based on field testing tentatively are scheduled for the summer of 1981.

INFORMAL INPUT:

We are very interested in your reaction to these materials. Your suggestions for additional activities are welcome.

Please feel free to contact the project director at the address listed below:

John Pope, project director
Mount St. Helens Curriculum Materials Project
Educational Service District 112
1313 N.E. 134th St.
Vancouver, Wash. 98665

ACTIVITY I — TYPES OF VOLCANOES

OBJECTIVE:
The student will be able to distinguish the three major types of volcanoes.

TEACHING SUGGESTIONS:
1. **Ask students to read the reference articles.**
2. **Discuss with the class the difference between the three types of volcanoes.**
3. **Do Activity I, "Three Types of Volcanoes" as a whole class activity.**

REFERENCE:
Volcanoes: Where and Why? Crustal Evolution Education Project, Ward's Natural Science Establishment, Inc. Rochester, N.Y.

ACTIVITY I — DEMONSTRATE THE THREE TYPES OF VOLCANOES BY BUILDING THREE MODELS

REFERENCE ARTICLES:
- "Three major types of volcanoes," Page 2
- "Scientists watch dome for signs of lava flow," Page 34
- "Dome might signal possibility of new blast," Page 35

MATERIALS:
Bucket
Sand, fine soil (for mud)
Sheet of plastic to protect floor
Water
Funnel
3 shallow boxes at least 15 inches square and 2 inches deep
Plaster or Fix-All

PROCEDURE:
1. Line each of three shallow boxes or box lids with plastic.

Model A. Cinder cone model:

Pour sand through a funnel and let it collect in a symmetrical pile in the box. Do this several times and note the shapes of the piles.

Model B. Shield Model:

Mix a bucket of mud to the consistency of thick gravy and pour it on a sheet of plastic in the box. It will help if some plaster or Fix-All is added to improve the consistency and give the lava a distinctive color. Let it stand until it firms up, then pour another layer over the first. The formation will be more visible if a few drops of vegetable coloring are added to each "layer." By carefully placing each pour, a shield formation should develop.

It will help the demonstration if the box has a layer of sand in it to absorb excess water.

Model C. Composite Model:

1.Pour out a small pile of sand. Then pour mud mixture containing plaster or Fix-All over it. When mud sets, pour more sand and then mud. Repeat until cone is built up.

2. Reread the "Three Types of Volcanoes," Page 2 of "Mount St. Helens."
3. Discuss the questions.

QUESTIONS:

Model A represents a cinder cone:

1. Why does the sand form a cone-shaped pile?

Material comes from a single point source (in this case the funnel) in a volcano, the crater. It falls down the sides until it comes to rest.

2. How steep were the slopes of the "cinder cone" and what differences did you note? (Use a protractor)

The angles were 30-35 degrees. The angle was the same whether the piles of sand were large or small.

3. What do you think determines the angle?

The particles roll down the slope because of gravity. The angle is constant and relates to the "resting" position. For steeper angles, the grains would roll down. For less steep angles, it would not roll and remain where it lands. This causes the angle to be constant for particles of a certain shape. (Angular blocks can form somewhat steeper slopes and spherical ones.)

4. How is the model similar or different from a real cinder cone?

It has a similar shape. Its origin is different, and the model has no crater. The sand came from above, while cinders come from underground.

Model B represents a shield volcano:

5. How does a shield volcano form?

One layer is added on top of another layer.

6. Why does a shield volcano form a more gentle slope than that of a cinder cone?

Lava (mud) runs down the mountain and does not pile up.

Model C represents a composite volcano:

7. What allows the composite volcano model to build a steeper cone than the shield volcano?

As the cinders (sand) keep building a cone over the layers of lava (mud) the cone shape is kept. Actual volcanoes will vary, depending upon the ratio of cinder to lava eruptions.

8. What type of volcano is Mount St. Helens? (Review the reading material and the diagrams in "Mount St. Helens".) Explain your answer.

Mount St. Helens is a composite volcano. It consists of layers of cinders and lava.

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ACTIVITY II — TYPES OF LAVA

The chart below shows the types of volcanic lava. A different amount of silica is found in each type of rock. The more silica present in the rock, the thicker the magma becomes.

Basalt	Less than 52% silica
Andesite	54-66% silica
Dacite	63-66% silica
Rhyolite	More than 66% silica

QUESTIONS:

1. Which lava is the runniest?

Basalt

2. Which lava is the thickest?

Rhyolite

3. Read the articles "Scientists watch dome for lava flow", Page 34, and "Idle dome might signal possibility of new blast," Page 35. What two types of rock would be most likely to form a "plug?" Why?

(A) Rhyolite and (B) Dacite. Because these two lavas are so thick, they are less likely to move quickly. Thus, they cool and become hard when they reach the top of the crater.

4. Most of the recent eruptions of Mount St. Helens have been of andesite and dacite. However, in the past there were some basalt eruptions. How do you think these two kinds of eruptions differed?

Basalts are the thinnest rock, so probably lava flowed over the side as a classic flow. Probably less pyroclastic material was released because the rock was thinner, more dense. Also, less ash would be emitted because less pressure would be needed.

EXTENDED ACTIVITY

Make a booklet showing the stages in the building of any of the three volcano types.

NAME: _____ DATE: _____

ACTIVITY I — DEMONSTRATE THE THREE TYPES OF VOLCANOES BY BUILDING THREE MODELS

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MATERIALS:

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It will help the demonstration if the box has a layer of sand in it to absorb excess water.

Model C. Composite Model:

1.Pour out a small pile of sand. Then pour mud mixture containing plaster or Fix-All over it. When mud sets, pour more sand and then mud. Repeat until cone is built up.

2. Reread the "Three Types of Volcanoes," Page 2 of the student tabloid.
3. Discuss the questions.

QUESTIONS:

Model A represents a cinder cone:

1. Why does the sand form a cone-shaped pile?

2. How steep were the slopes of the "cinder cone" and what differences did you note? (Use a protractor)

3. What do you think determines the angle?

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4. How is the model similar or different from a real cinder cone?

Model B represents a shield volcano:

5. How does a shield volcano form?

6. Why does a shield volcano form a more gentle slope than that of a cinder cone?

Model C represents a composite volcano:

7. What allows the composite volcano model to build a steeper cone than the shield volcano?

8. What type of volcano is Mount St. Helens? (Review the reading material and the diagrams in "Mount St. Helens".) Explain your answer.

NAME:_____ DATE:_____

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NAME: _____ DATE: _____

EXTENDED ACTIVITY

Make a booklet showing the stages in the building of any of the three volcano types.

VOLCANO BACKGROUND — TIME LINE

OBJECTIVE:

The students will make a timeline of the activity of Mount St. Helens over the years and compare it to three other time lines.

TEACHER BACKGROUND:

The students will be reading articles on the history of volcanoes and Mount St. Helens. Mount St. Helens' history goes back about 37,500 years, and scientists have been able to plot its eruptive history for about the past 8,000 years.

TEACHING SUGGESTIONS:

1. In "Mount St. Helens" and in Appendix V, you will find the history of Mount St. Helens. The students will make four time lines. Each student will compare the four suggested time lines and should notice that he or she has only been around a very short time.

2. For extended use, you may want to compare the time lines with a geological time line of the earth.

TIME TABLE FOR MOUNT ST. HELENS

REFERENCE ARTICLES:

— "Violent past for St. Helens," Page 50
— "Mount St. Helens has erupted many times," Page 3
— "Eruptions in past have killed many," Page 36
— Appendix V — Gifford Pinchot National Forest fact sheet, July 10, 1980.

MATERIALS:

Ruler
Pencil

PROCEDURE:

1. Read the reference articles, keeping in mind other important events in our history.

2. Tape together sheets 1 and 2. Be sure B.C. is to the left on the time line. Record the eruptions of Mount St. Helens on the time line. Use sheets and make a time line of important events in your life. Start with when you were born, your first step, your first word, when you started school, rode your bicycle the first time, or any other important event you can think of.

3. On the same chart, make a time line of the history of North America. Use a different color. Include the following dates:

- Hopewell Indian Culture — 300 B.C.
- Mississippian Tribal Culture — 600 A.D.
- Great Pueblo Period — 1000 A.D.
- Viking Exploration — 1000 A.D.
- Columbus Discovery — 1492 A.D.
- Jamestown Settlers — 1620 A.D.
- Signing of the Declaration of Independence — 1776 A.D.
- The Civil War — 1861 A.D.
- World War I and II — 1919 and 1941 A.D.
- Alaska's Statehood — 1959 A.D.
- Man on the Moon — 1970 A.D.

(Check an almanac for other significant dates.)

4. Still on the same time line, in a third color, record the historic eruptions of other volcanoes.

QUESTIONS:

1. What are two things you notice when you compare volcanic eruption time lines with other kinds of time lines?

Volcanic eruptions have been a part of the earth forming process for much of recorded history and are likely to remain a changing force. "Volcano history" has been going on much longer than recorded "people history."

2. Do you know of any volcanic eruption that may have changed the course of history?

Pompeii and Atlantis

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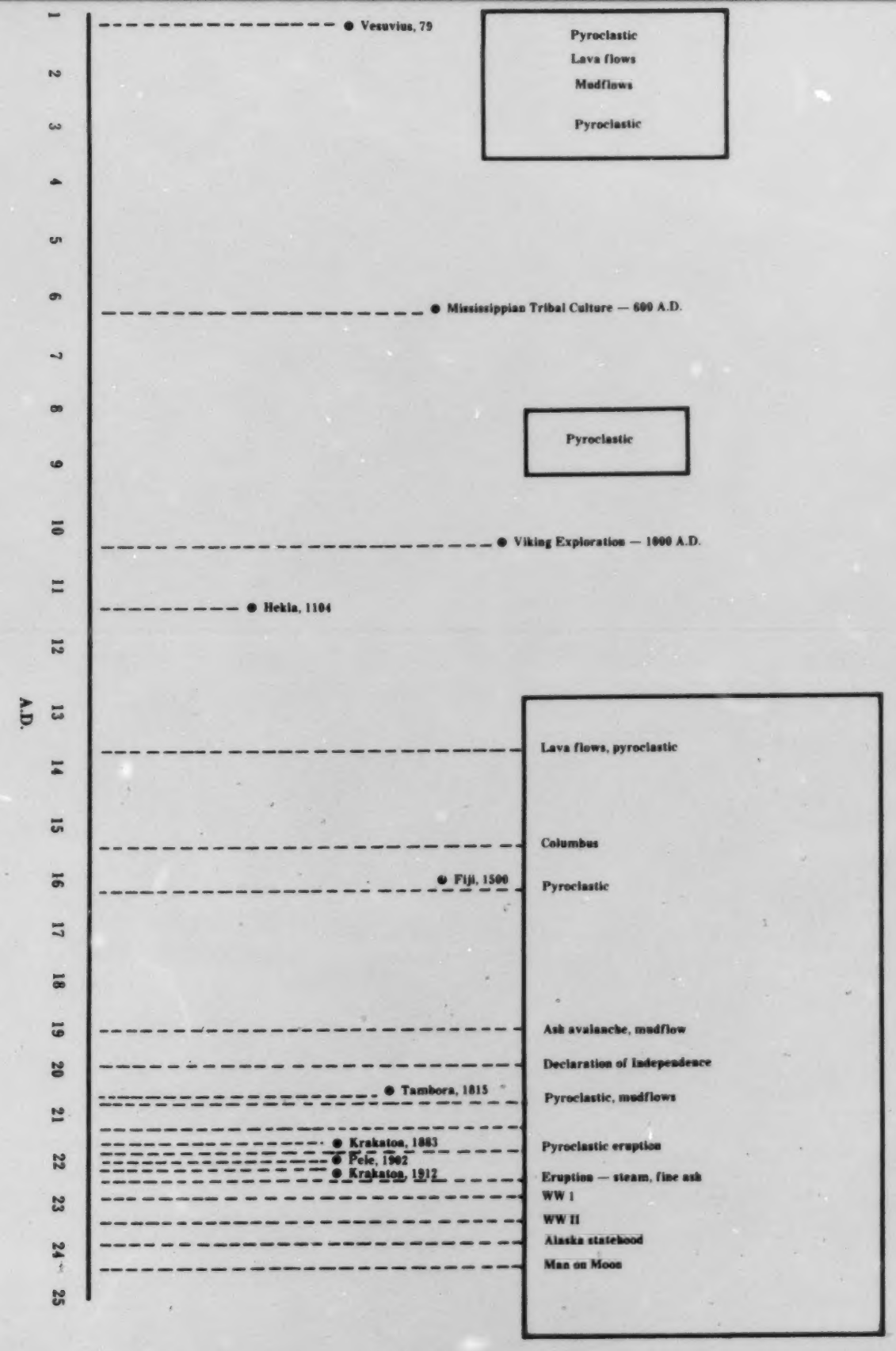
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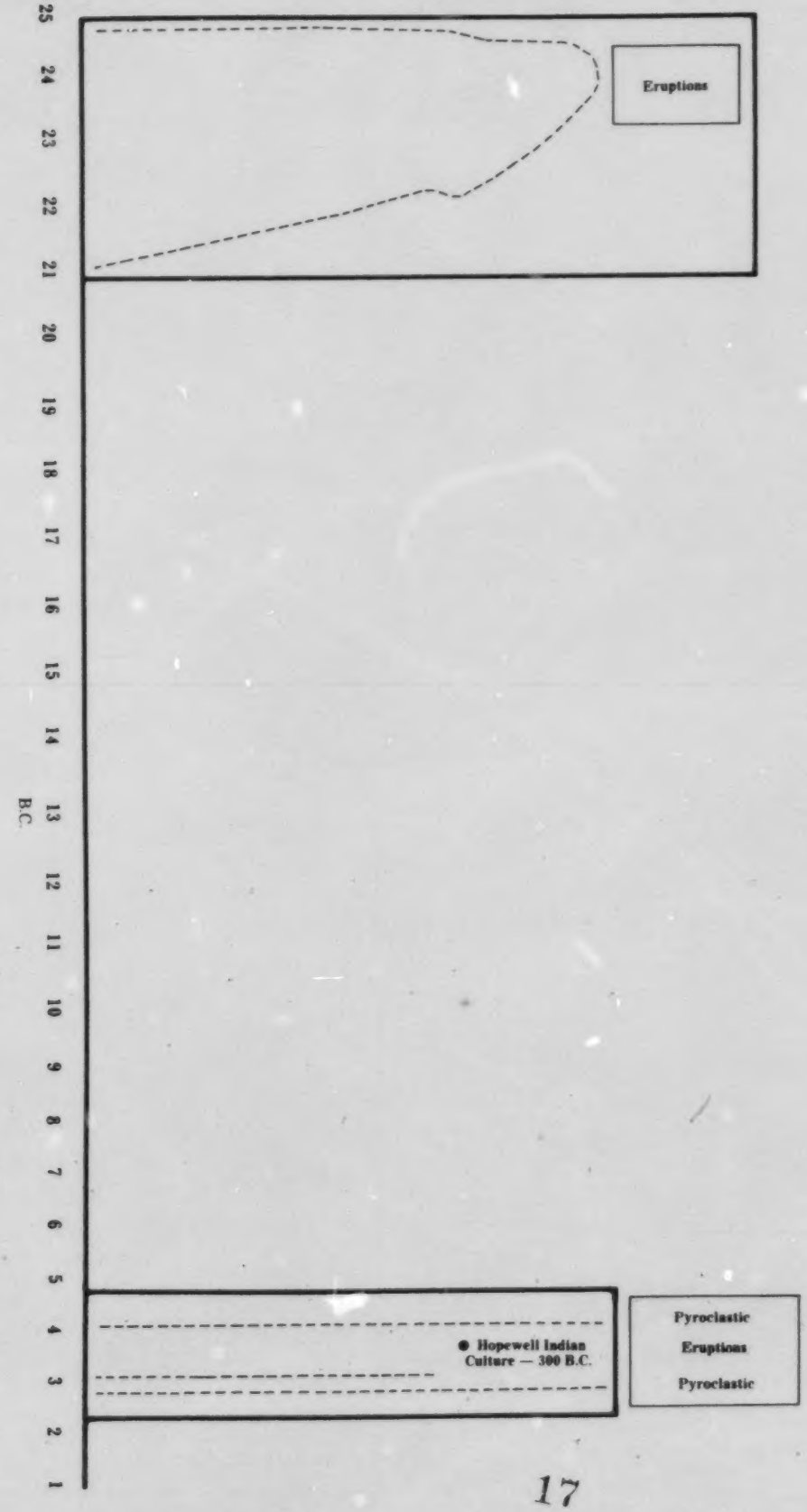
Man on Moon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NAME: _____ DATE: _____

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- World War I and II — 1919 and 1941 A.D.
- Alaska's Statehood — 1959 A.D.
- Man on the Moon — 1970 A.D.

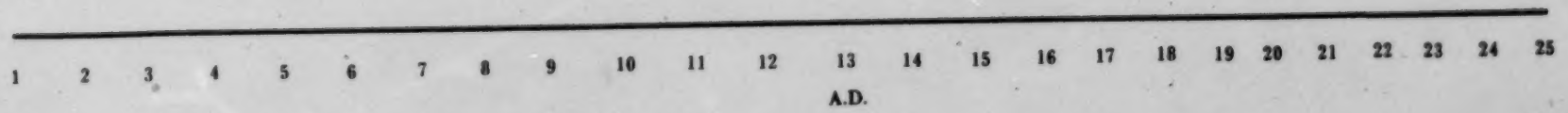
(Check an almanac for other significant dates.)

4. Still on the same time line, in a third color, record the historic eruptions of other volcanoes.

QUESTIONS:

1. What are two things you notice when you compare volcanic eruption time lines with other kinds of time lines?

2. Do you know of any volcanic eruption that may have changed the course of history?



19

20

25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

B.C.

21

22

LEVEL INFORMATION: SS, SCI, MATH MS, HS

BUILDING MOUNT ST. HELENS FROM A TOPOGRAPHIC MAP

OBJECTIVES:

The student will:

1. Build a scale model of Mount S.. Helens before the May 18 eruption from clay.
2. Demonstrate the ability to read a simple topographic map.

TEACHING SUGGESTIONS:

1. Divide the class into three or four teams. Rather than have each student build a mountain, have each team do so.
2. Demonstrate molding clay on the template before students start.
3. Explain to the students that there is a 2:1 vertical exaggeration in the final product.

BUILDING MOUNT ST. HELENS FROM A TOPOGRAPHIC MAP

REFERENCE ARTICLES:

— Photos on Pages 3, 5, 6 and 50

MATERIALS:

— U.S. Geologic Survey Mount St. Helens Topographic Quadrangle Map.
— Templates of the 4,000-, 5,000-, 6,000-, 7,000-, 8,000- and 9,000-foot levels of Mount St. Helens.
— Play dough, clay or flour and salt clay
— Toothpicks and tape (optional).

BACKGROUND:

A topographic map is a series of lines drawn at a specific altitude. On the USGS map with this activity, those lines connect points of equal altitude. The numbers on the lines are the altitude in feet. The mountain you construct will approximate the shape of Mount St. Helens before the May 18 eruption.

PROCEDURE:

1. Place template 1 (4,000-foot level) on a flat surface.
2. Mold a piece of clay to fit **within** the lines. Be sure the clay remains at least 1 cm thick and stays within the lines.
3. Repeat this activity on templates 2 through 6.
4. Using drawing 7 for reference, place each of the pieces of clay on top of one another (2 on top of 1, 3 on top of 2, 4 on top of 3, 5 on top of 4 and 6 on top of 5).
5. Mold the clay to the general shape of Mount St. Helens. You now have a scale model of Mount St. Helens.

QUESTIONS:

1. Look at the USGS topographic map included with this activity. What is the altitude at the highest point on Mount St. Helens on May 17, 1980?

9,677 feet

2. What landmark is at approximatley 9,200 feet?

False summit

3. What is the altitude at Windy Pass?

4,800 feet

4. What is the altitude at Timberline Campground?

4,400 feet.

5. What is the altitude at June Lake?

3,200 feet.

EXTENDED ACTIVITIES

Using toothpicks, tape and the map, put labels on the location of each of the major landmarks on Mount St. Helens.

NAME:_____ DATE:_____

BUILDING MOUNT ST. HELENS FROM A TOPOGRAPHIC MAP

REFERENCE ARTICLES:
— Photos on Pages 3, 5, 6 and 50

MATERIALS:
— U.S. Geologic Survey Mount St. Helens Topographic Quadrangle Map.
— Templates of the 4,000-, 5,000-, 6,000-, 7,000-, 8,000- and 9,000-foot levels of Mount St. Helens.
— Play dough, clay or flour and salt clay.
— Toothpicks and tape (optional).

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2. Mold a piece of clay to fit **within** the lines. Be sure the clay remains at least 1 cm thick and stays within the lines.
3. Repeat this activity on templates 2 through 6.
4. Using drawing 7 for reference, place each of the pieces of clay on top of one another (2 on top of 1, 3 on top of 2, 4 on top of 3, 5 on top of 4 and 6 on top of 5).
5. Mold the clay to the general shape of Mount St. Helens. You now have a scale model of Mount St. Helens.

QUESTIONS:
1. Look at the USGS topographic map included with this activity. What is the altitude at the highest point on Mount St. Helens on May 17, 1980?

2. What landmark is at approximately 9,200 feet?

3. What is the altitude at Windy Pass?

4. What is the altitude at Timberline Campground?

5. What is the altitude at June Lake?

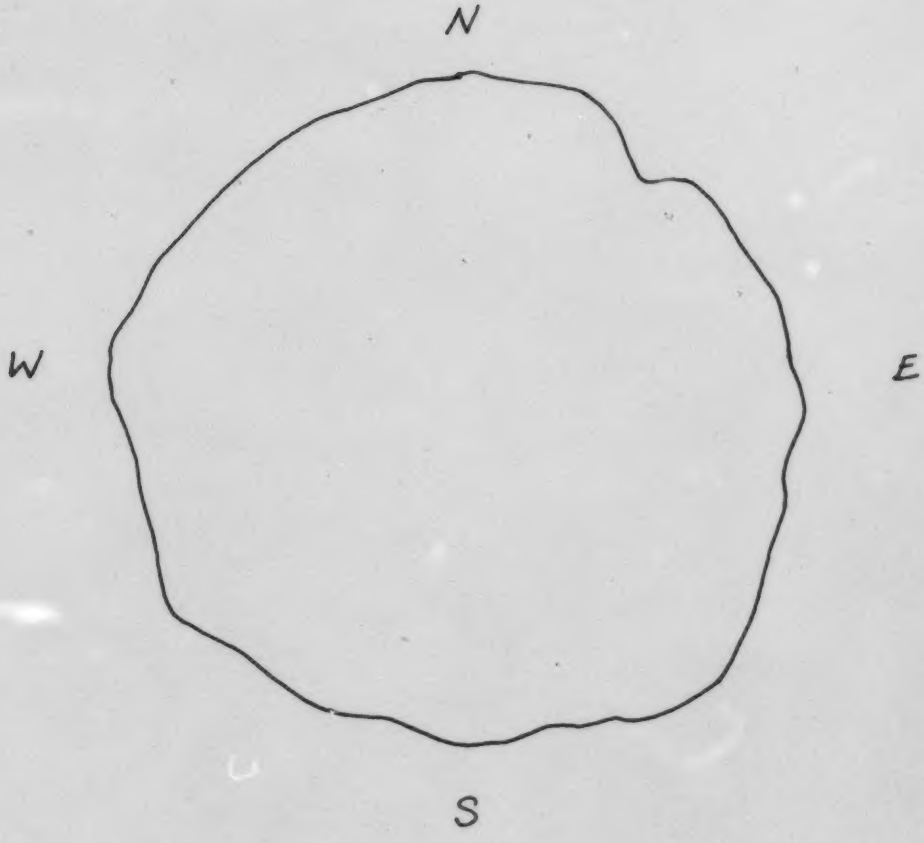
EXTENDED ACTIVITIES

Using toothpicks, tape and the map, put labels on the location of each of the major landmarks on Mount St. Helens.

4,000 ft Level
Make clay 1cm. thick

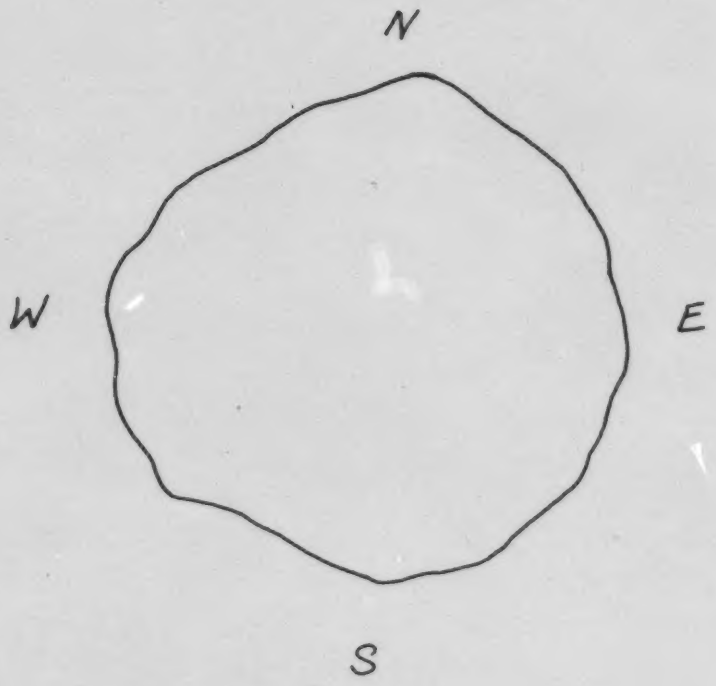
26

Template 1



5,000 ft. Level
Make clay 1 cm. thick.

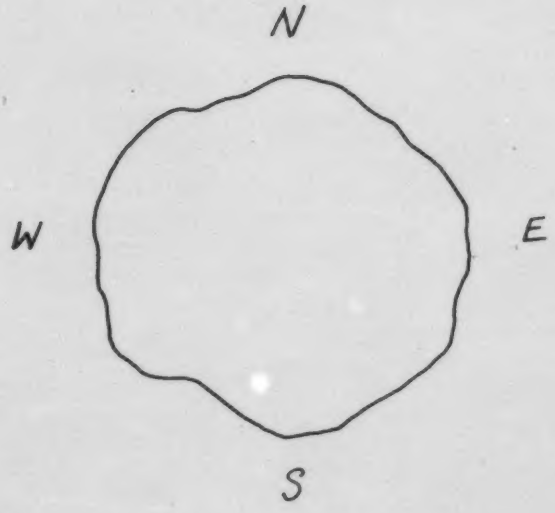
Template 2



28

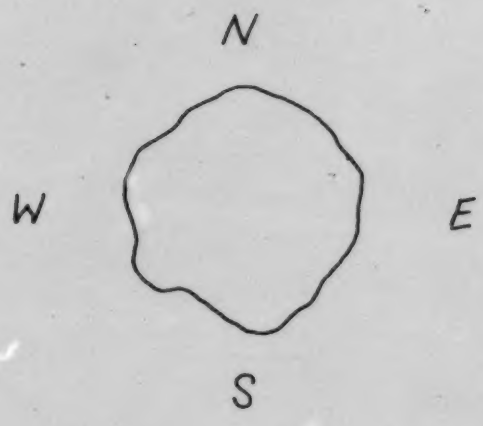
6,000 ft. Level
Make clay 1cm. thick.

Template 3



Template 4

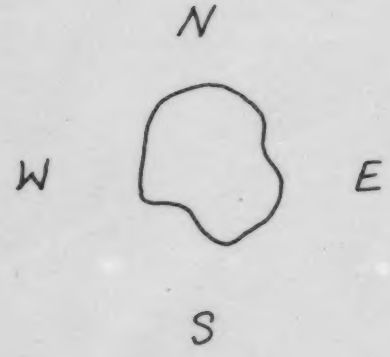
7,000 ft. Level
Make clay 1cm. thick



30

Template 5

8,000 ft. Level
Make clay 1 cm. thick.

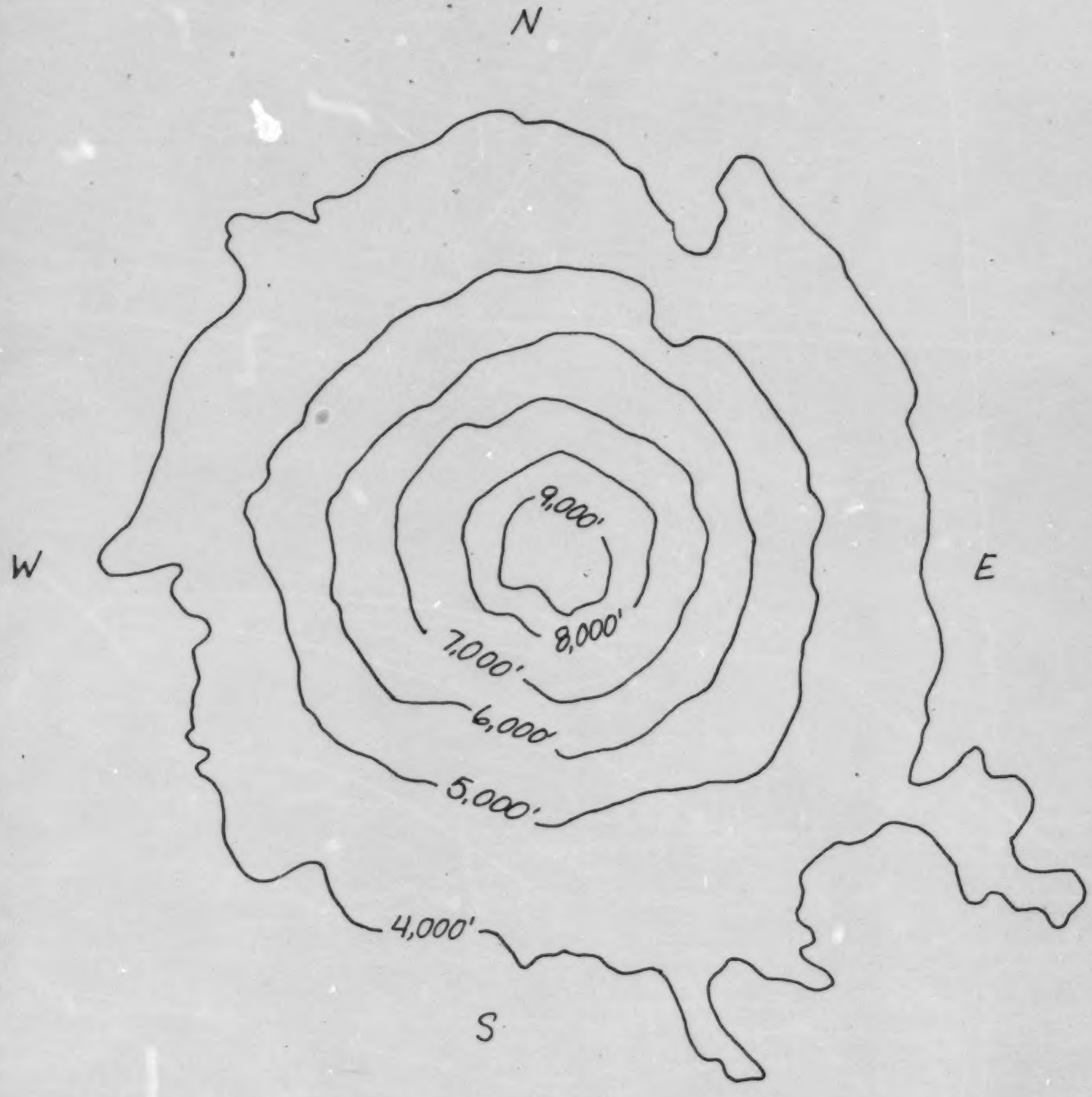


9,000 ft. Level
Make clay 1 cm. thick.

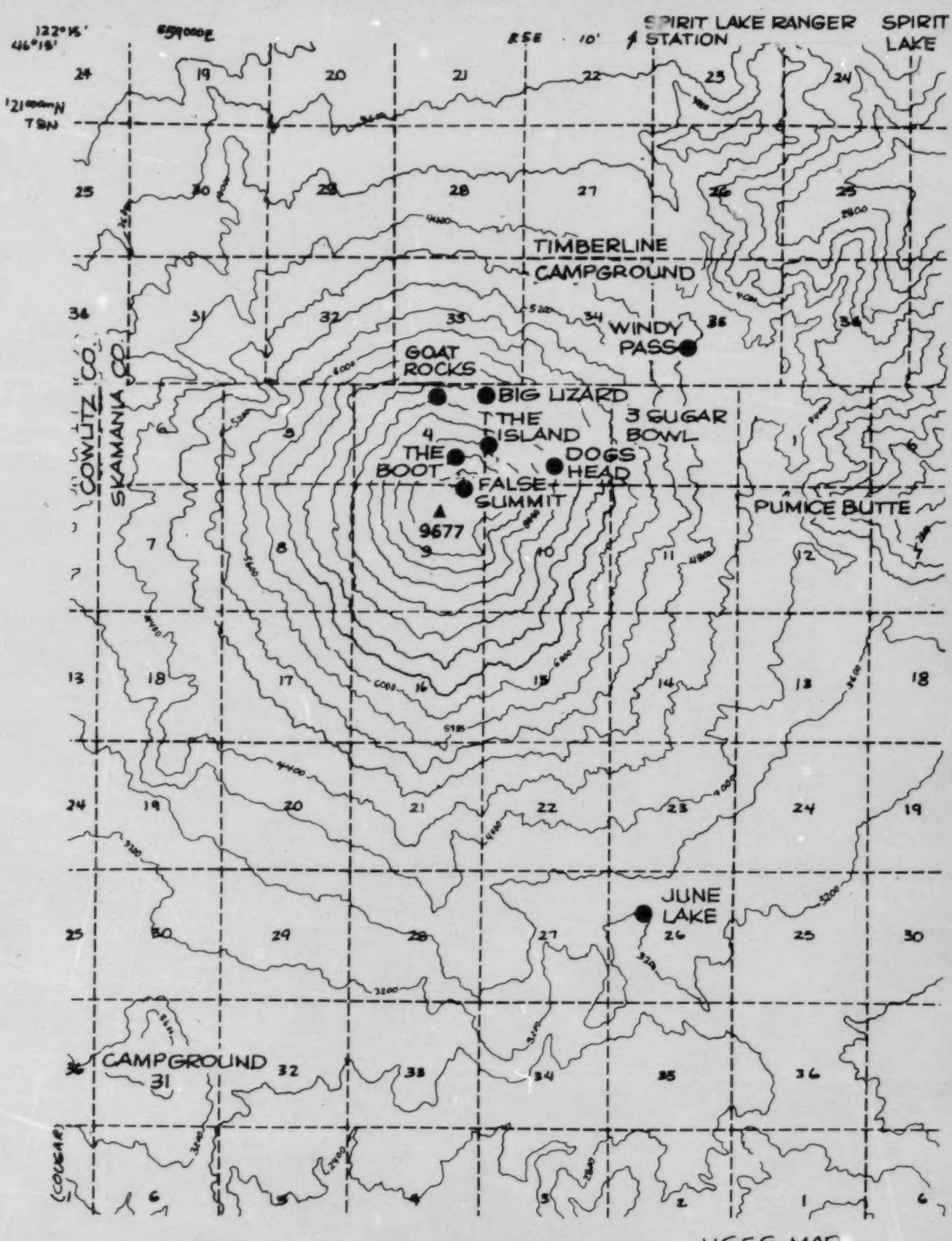
Template 6

23

31



32 Mount St. Helens
Drawing #7


SPIRIT LAKE RANGER STATION
SPIRIT LAKE
TIMBERLINE CAMPGROUND
WINDY PASS
GOAT ROCKS
BIG LIZARD
THE ISLAND
3 SUGAR BOWL
THE BOOT
DOGS HEAD
FALSE SUMMIT
9677
PUMICE BUTTE
JUNE LAKE
CAMPGROUND
COWLITZ CO.
SKAMANIA CO.
USGS MAP

LEVEL INFORMATION: SS,LA MS, HS

MYTHS

OBJECTIVES:
The students will: 1. Discuss why people long ago created stories about natural phenomena.
2. Write a myth.
3. Illustrate their own and/or Indian myth.

TEACHING SUGGESTIONS:
1. Tell the students to read the reference articles.
2. Discuss why people long ago created stories about volcanoes and earthquakes.
3. Discuss why the Indians were the first to create myths about Mount St. Helens, Mount Adams and Mount Hood.
4. Discuss how earthquakes and volcanoes are alike.
5. If possible, have someone from the local historical society visit the class, bringing in artifacts relating to local legends and myths.

MYTHS

REFERENCE ARTICLES:
— "Cowlitz Indians say St. Helens is angry," Page 4.
— "1847 blasts kept Indians from peak," Page 4
— "Mountain 'disturbed too often," Page 5
— "Bottle of gin to be tossed in pit," Page 5

PROCEDURE:

1. Read the reference articles. Write the two names given Mount St. Helens and the tribe associated with the name below.

Si Yett (Yakima Indians) and Lawelatla (Cowlitz Indians)

2. Read the following description of other myths and legends:

Long ago, people did not know or understand what caused volcanoes and earthquakes. Many people were frightened by the mysterious rumblings inside the earth and the flows of lava. They explained these things through myths.

For instance, before Magellan sailed around the world, some people believed that the earth was flat and held up by two elephants standing on a turtle's back. When the earth shook, it was thought that the elephants were moving.

Other people thought that giant whales, slapping their tails against the ocean floor, caused the earth to tremble. Or, some thought, perhaps sea monsters were fighting.

Ancient Romans believed that Vulcan, (Latin Volcanus, Vulcanus), the god of fire and metal working, had a blacksmith shop under certain mountains. They believed that his main shop was under a mountain on an island near Sicily. The island is known as Vulcano. Its name became our word "volcano."

3. What three things were used to explain earthquakes?

(1) Elephants moving on turtle's back; (2) giant whales slapping tails on ocean floor; and (3) sea monsters fighting.

4. Read the stories below about Mount St. Helens.

Indians of the Pacific Northwest watched eruptions of Mount St. Helens long before the white man came. Early accounts of eruptions were handed down and accounted for in Indian legends. Here are some of the more popular versions.

From Puyallup Indians

A long time ago a huge landslide of rocks roared into the Columbia River near Cascade Locks and

eventually formed a natural bridge. The bridge came to be called Tamanawas Bridge, or Bridge of the Gods. In the center of the arch the only fire in the world burned, so of course it was sacred to the Indians. They came from north, south, west and east to get embers for their own fires from the sacred fire.

A wrinkled old woman, Loowitlatkla ("Lady of Fire"), lived in the center of the arch, tending the fire. Loowit, as she was called, was so faithful in her task and so kind to the Indians who came for fire that she was noticed by the great chief Tyee Sahale. He had a gift he had given to very few others — among them his sons Klickitat and Wyeast — and he decided to offer this gift to Loowit. The gift he bestowed on Loowit was that she would have eternal life. But Loowit wept because she did not want to live forever as an old woman.

Sahale could not take back the gift, but he told Loowit he could grant her one wish. Her wish, to be young and beautiful, was granted, and the fame of her wondrous beauty spread far and wide.

One day Wyeast came from the land of the Multnomahs to see her. Just as he arrived at Tamanawas Bridge (a natural stone bridge that, according to Indian lore, once spanned the Columbia River), Klickitat came thundering down from the north. Both brothers fell in love with Loowit, but she could not choose between them. Klickitat and Wyeast had a tremendous fight. They burned villages. Whole forests disappeared in flames.

Sahale watched all of this fury and became very angry. He frowned. He struck Tamanawas Bridge, and it fell into the river where it boils in angry protest. He smote the three lovers, too, but even as he punished them he loved them. So where each lover fell he raised up a mighty mountain. Because Loowit was beautiful the mountain (St. Helens) is a symmetrical cone, dazzling white. Wyeast (Mount Hood) lifts his head in pride. Klickitat (Mount Adams), for all his rough ways, had a tender heart. He bends his head in sorrow as he weeps to see the beautiful maiden wrapped in snow.

From Yakima Indians:

Si Yett ("woman") is the Yakima Indian name for Mount St. Helens. According to legend, Si Yett was a beautiful white maiden placed on earth by the Great Spirit to protect the Bridge of the Gods on the Columbia River from the battling Mount Adams and Mount Hood.

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Klickitat Indians tell of two braves, Pahto (Mount Adams) and Wyeast (Mount Hood), who fought to win affections of an ugly hag who'd been turned into a beautiful maiden by the Great Spirit.

From Cowlitz Indians

Cowlitz Indian legends tell of a time when Mount Rainier had an argument with his two wives, Mount St. Helens and Mount Adams. Mount St. Helens became jealous, blew her top and knocked the head off Mount Rainier.

Cowlitz Indians called Mount St. Helens "Lavelatla," which means "smoking mountain."

5. Why did the Indians make up myths about Mount St. Helens?

They didn't have a scientific explanation and needed to explain things they observed.

6. How are all the Indian identities of Mount St. Helens the same?

Mount St. Helens was always a person, not an animal.

7. Sometimes the mountain was female, sometimes male, but always there was a reason for the mountain to erupt. This reason was the basis for its identity. Select another identity for Mount St. Helens, either animal or human. List below some of the words associated with its identity before and during eruption.

Before eruption:

Answers will vary.

35

During eruption:

Answers vary. (If the students are not accustomed to this technique, "brainstorm" one example on the board as an illustration.)

8. In eight steps list what happens to your identity for Mount St. Helens from before the eruption, to the eruption, to following the eruption. Include any extra characters needed (for example, Mount Hood or the Columbia River.

1.

2.

3.

4.

5.

Answers vary

6.

7.

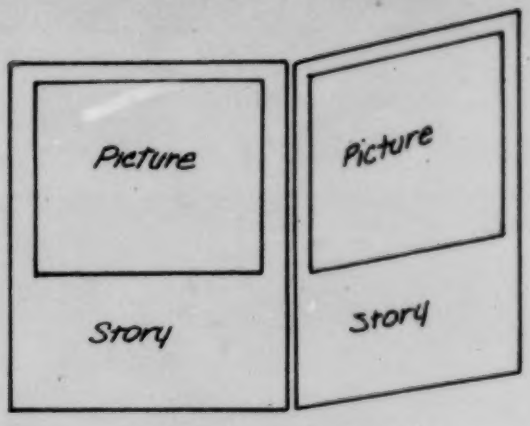
8.

9. Write your story about Mount St. Helens. Be sure to include necessary words from the list you have just made in Question 8.

10. Repeat steps 7 through 9, only find a new identity for another natural phenomenon (e.g. hurricane).

This could be done as an alternate acivity to the one described in 7 through 9, if desired).

11. Select one of your myths and write a book for younger students. Each page should be mostly illustration and have very little writing.



a. Your book may look different than this. The book may be as long as 10 pages. Be sure each picture you choose or draw fits the part of the story on that page.

b. Make the pages of the book 8½ by 11 inches. They can be any color.

c. Cut a piece of white paper for each page of the story. Carefully print the part of the story for that page, making sure the picture will fit above the story. Paste onto the 8½ by 11 book paper.

d. Color the pictures on a separate piece of paper. Then cut them out and paste onto 8½ by 11 book page (see above). Be sure that it will fit above the text.

e. When you are finished with the story, add one blank sheet at the beginning and end and staple the pages together (see below). Use enough staples to hold the book together firmly.

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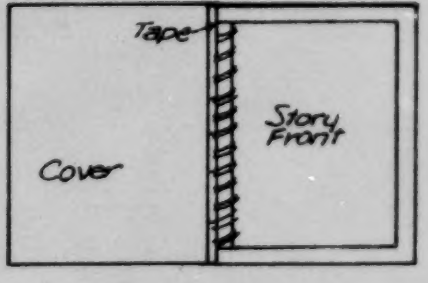

g. The book can now be placed in the library, another classroom or in your own classroom.

Be sure your students share their stories with classmates.

EXTENDED ACTIVITY

1. Make an illustration depicting your legend on a piece of white 8½-by-11-inch typing paper, using fabric crayons. Following crayon instructions, transfer your legend onto fabric. The illustrations could also be appliqued on a T-shirt or used as part of a class quilt.

2. Become an interviewer. Ask another student (or teacher) to play the part of one of the legendary characters discussed in the stories. Interview that legendary person. Write below the questions you want to ask.

1.

2.

3.

4.

Record or, if possible, videotape the interviews to be used in ways such as: sharing at Parent's Night; sharing with younger students; or building a volcano reference library.

NAME: _____ DATE: _____

MYTHS

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1.

2.

3.

4.

5.

6.

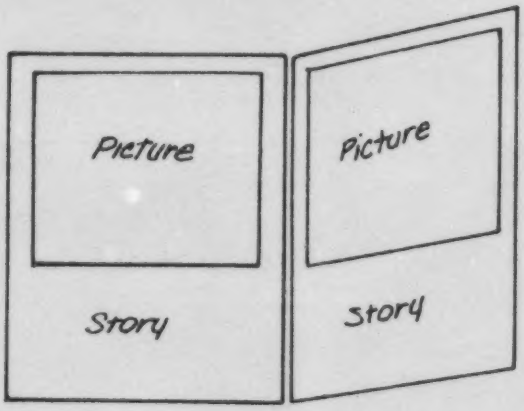
7.

8.

9. Write your story about Mount St. Helens. Be sure to include necessary words from the list you have just made in Question 8.

10. Repeat steps 7 through 9, only find a new identity for another natural phenomenon (e.g. hurricane).

11. Select one of your myths and write a book for younger students. Each page should be mostly illustration and have very little writing.



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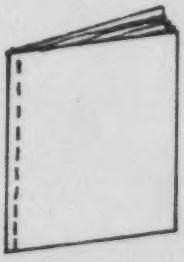

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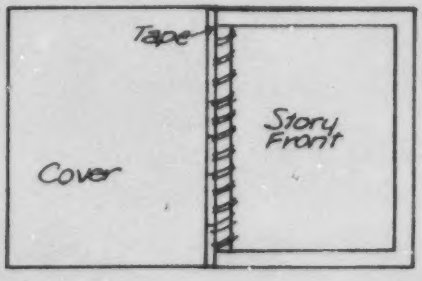

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NAME:_____ DATE:_____

EXTENDED ACTIVITY

1. Make an illustration depicting your legend on a piece of white 8½-by-11-inch typing paper, using fabric crayons. Following crayon instructions, transfer your legend onto fabric. The illustrations could also be appliqued on a T-shirt or used as part of a class quilt.
2. Become an interviewer. Ask another student (or teacher) to play the part of one of the legendary characters discussed in the stories. Interview that legendary person. Write below the questions you want to ask.

1.

2.

3.

4.

Record or, if possible, videotape the interviews to be used in ways such as: sharing at Parent's Night; sharing with younger students; or building a volcano reference library.

42

LEVEL INFORMATION: LA, SCI MS, HS

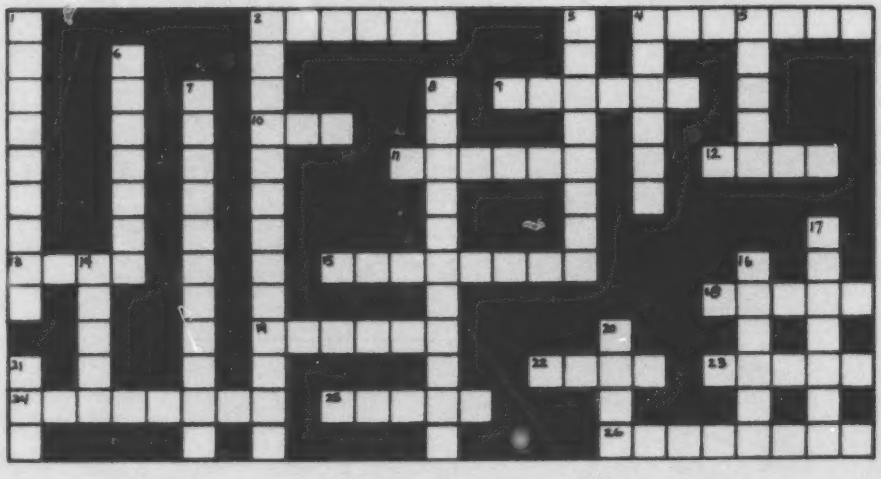
ERUPT-A-WORD PUZZLE

OBJECTIVE:
To familiarize the students with various volcano terms and/or definitions.

TEACHER BACKGROUND:
Students should be familiar with the words used in this puzzle before attempting to solve it.

ERUPT-A-WORD PUZZLE

REFERENCE:
— "Glossary of volcanic terms," Page 51



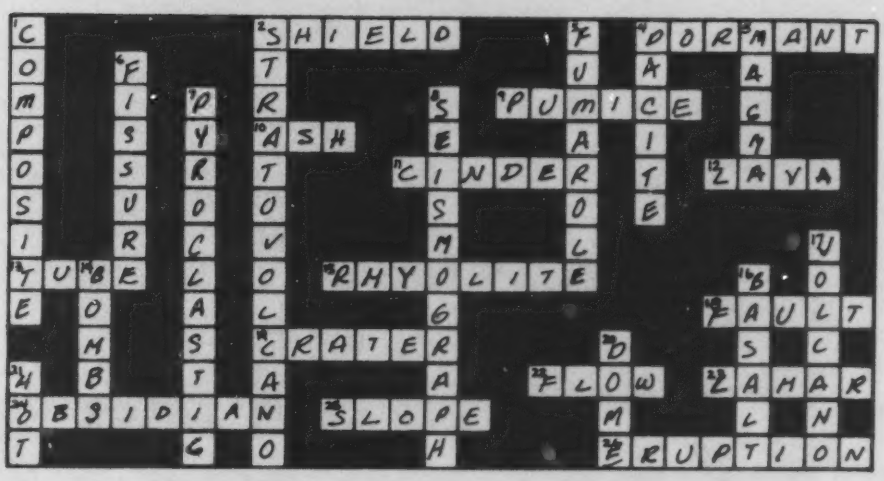
ACROSS:

2. Broad, sloping volcano
4. "Sleeping"
9. Buoyant, solidified rock-glass
10. Pulverized rock from eruption
11. Loose, fragmental volcanic cone
12. Magma which has reached the surface
13. Cave inside a lava flow
15. Lava rock rich in silica and glass
18. Crack in earth's surface
19. Bowl-shaped hollow at or near top of volcano
22. Lava_____
23. Indonesian term for volcanic mudflow
24. Dense, black, glassy, volcanic rock
25. Incline
26. Ejection of solid, liquid and gaseous materials

DOWN:

1. Lava cone made of lava flows and fragmental materials
2. A composite volcanic cone
3. Vent issuing steam or other gases
4. Thick, pasty lava with high silica content
5. Molten rock beneath earth's surface
6. Cracks on slopes of volcano
7. _____ flow; flow of hot gas and fragmental material
8. Instrument that records earthquakes
14. Fragment of molten rock blown from volcano and shaped during flight and impact
16. Lava poor in silica, rich in magnesium
17. Mountain built by eruption
20. Rounded pile of lava formed by eruption
21. _____ avalanche; glowing avalanche

ERUPT-A-WORD PUZZLE KEY



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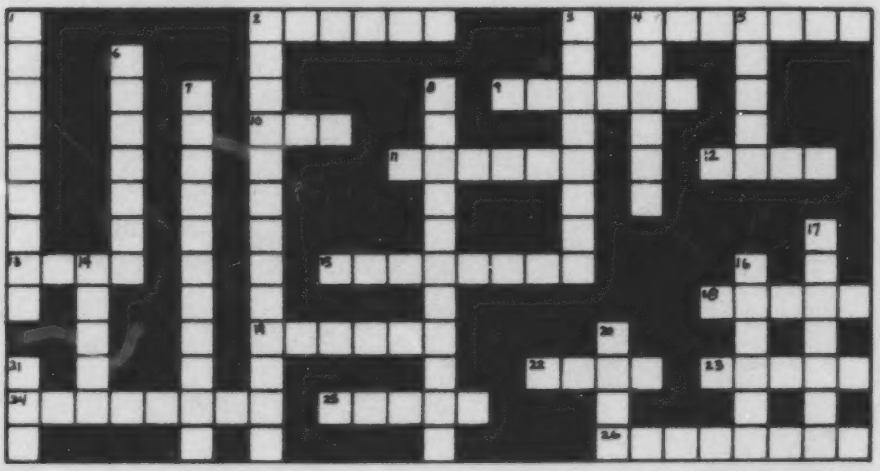
NAME: _____ DATE: _____

ERUPT-A-WORD PUZZLE

REFERENCE:
— "Glossary of volcanic terms," Page 51



ACROSS:

2. Broad, sloping volcano
4. "Sleeping"
9. Buoyant, solidified rock-glass
10. Pulverized rock from eruption
11. Loose, fragmental volcanic cone
12. Magma which has reached the surface
13. Cave inside a lava flow
15. Lava rock rich in silica and glass
18. Crack in earth's surface
19. Bowl-shaped hollow at or near top of volcano
22. Lava _____
23. Indonesian term for volcanic mudflow
24. Dense, black, glassy, volcanic rock
25. Incline
26. Ejection of solid, liquid and gaseous materials

DOWN:

1. Lava cone made of lava flows and fragmental materials
2. A composite volcanic cone
3. Vent issuing steam or other gases
4. Thick, pasty lava with high silica content
5. Molten rock beneath earth's surface
6. Cracks on slopes of volcano
7. _____ flow; flow of hot gas and fragmental material
8. Instrument that records earthquakes
14. Fragment of molten rock blown from volcano and shaped during flight and impact
16. Lava poor in silica, rich in magnesium
17. Mountain built by eruption
20. Rounded pile of lava formed by eruption
21. _____ avalanche; glowing avalanche

LEVEL INFORMATION: SS, LA MS

ACTIVITY I — PREDICTIONS

OBJECTIVES:
The students will:
1. Define "prediction."
2. Describe how predictions are related to Mount St. Helens.
3. Apply the definition for prediction to making a prediction.
4. Compare scientific and non-scientific predictions.

TEACHFR BACKGROUND:

To study a volcano in action is a once-in-a-lifetime experience for most geologists. Mount St. Helens has been dormant for 123 years. A minor earthquake measuring 4.1 on the Richter Scale occurred on March 20, 1980. On March 26, 1980, federal, state and local officials met to discuss possible evacuation procedures.

On March 27, 1980, a loud boom was heard 40 miles away. The eruption spread ash over 2 kilometres above the summit. Other eruptions took place, including the May 18, 1980, blast that was so destructive and caught many experts by surprise by its severity.

But prediction techniques improved. At 12:35 p.m. August 7, the USGS and US Forest Service ordered evacuation within the Red Zone, based on the predictions they had made as early as July 29 resulting from experience with the mountain and patterns that were emerging. At 4:28 p.m. that day, Mount St. Helens erupted again.

People look to geologists to be forecasters of volcanic activity. Geologists are expected to be like weathermen, who predict clear or cloudy skies. However, in their defense, it should be noted that little information is available to help these talented scientists predict volcanoes. One of the jobs of a geologist is to record the events as they occur in a volcano. Information is gained as the geologists make repeated observations. Patterns eventually emerge, making it possible to predict volcanic activities with increasing confidence and accuracy.

TEACHING SUGGESTIONS:

Assign articles to be read by the students or read the articles aloud to students. Discuss with students the meaning of the word "prediction." Predictions are somewhat more than a guess. They are based upon information gathered over a period of time.

Ask the student to look in the articles for clues that helped forecast the eruption of Mount St. Helens. Ask students to report clues they found. Use the questions as guides for open discussion. Accept any reasonable answer.

After finishing this unit you may want to review the unit on Harry Truman. (See Table of contents).

ACTIVITY 1 — PREDICTIONS

REFERENCE ARTICLES:
- "Geologist calms Toutle residents," Page 6.
- "Prediction found in rock," Page 6.
- "Predictions more accurate as time goes on", Page 6.
- "Pains give psychic hint on St. Helens," Page 7.

PROCEDURE:

Read the articles on Pages 6 and 7 of "Mount St. Helens." Answer the following questions:

1. What is a prediction?

A carefully made scientific forecast based on all the information available.

2. Did ancient civilizations predict the future? Were they accurate?

Yes. In many cases, the ancients came very close to accurately predicting modern events.

3. Using the definition for prediction, make a prediction about something, e.g. weather, elections, a friend. What was the basis for your prediction?

Answers should show application of the definition. The prediction should be based on some type of objective information.

4. If you lived on the Toutle River, how would you have felt about a geologist telling you that Mount St. Helens might erupt? Would you stay or leave? Explain your answer.

Many answers are acceptable. The student should take a position and defend it.

5. Define "precaution."

Planning to react to a disaster.

6. What precautions were taken before and after the May 18, 1980, eruption?

Students should list such precautions as U.S. Forest Service Red Zones, Toutle evacuation plans, etc. After the eruption of May 18, 1980, more precautions were taken, such as plans to evacuate several cities.

7. If you lived near a mountain with a volcanic history, would Mount St. Helens make you take a second look at your mountain's activity? If yes, explain your answer.

Students should indicate two or three reasons for answer — comparison, similar history, distance live from mountain.

ACTIVITY II — MAKE YOUR OWN PREDICTIONS

PROCEDURE:

Bring a rock to school. It should be interesting to you.

QUESTIONS:

1. Find pictures in your rock. Tell about the pictures you have imagined.

Encourage students to use their imagination to create ideas from patterns in their rock.

2. What might your rock foretell.

Any answer is acceptable here.

3. How is a rock prediction different than a scientific prediction?

The rock prediction is not based on fact, while scientific predictions are.

4. (a) The scientific community might have strong objections to articles such as "Prediction found in rock." How do you think scientists feel about such articles?

Scientists fear people may not realize that their predictions are scientific, not intuitive. Some readers may have more faith in rocks instead of scientists.

(b) Why do they feel this way?

This misconception limits the effectiveness of the scientist.

(c) How might a scientist combat these articles?

A scientist needs to gain credibility by having their experiments publicized through various media. If science communicates with the layman, they eventually may lend less credence to the soothsayer.

NAME: _____ DATE: _____

ACTIVITY I — PREDICTIONS

REFERENCE ARTICLES:
- "Geologist calms Toutle residents," Page 6.
- "Prediction found in rock," Page 6.
- "Predictions more accurate as time goes on," Page 6.
- "Pains give psychic hint on St. Helens," Page 7.

PROCEDURE:
Read the articles on Pages 6 and 7 of "Mount St. Helens." Answer the following questions:

1. What is a prediction?

2. Did ancient civilizations predict the future? Were they accurate?

3. Using the definition for prediction, make a prediction about something, e.g. weather, elections, a friend. What was the basis for your prediction?

4. If you lived on the Toutle River, how would you have felt about a geologist telling you that Mount St. Helens might erupt? Would you stay or leave? Explain your answer.

5. Define "precaution."

6. What precautions were taken before and after the May 18, 1980, eruption?

7. If you lived near a mountain with a volcanic history, would Mount St. Helens make you take a second look at your mountain's activity? If yes, explain your answer.

NAME: _____ DATE: _____

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QUESTIONS:

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2. What might your rock foretell.

3. How is a rock prediction different than a scientific prediction?

4. (a) The scientific community might have strong objections to articles such as "Prediction found in rock." How do you think scientists feel about such articles?

(b) Why do they feel this way?

(c) How might a scientist combat these articles?

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LEVEL INFORMATION: SCI MS, HS

DEMONSTRATION — FUMAROLES

OBJECTIVE:

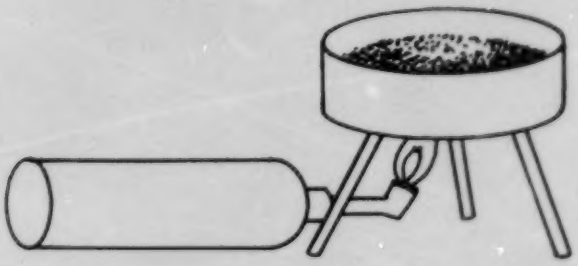
The students will observe how fumarole activity forms around volcanic areas.

MATERIALS:

Small metal cup (or shallow can such as a tuna fish can)
Fine sand
Tripod (or other stand)
Bunsen burner (propane torch)
Water
Ice cube

PROCEDURE:

1. **Place the can on the stand.**
2. **Add about ¼ inches to ½ inches sand.**
3. **Moisten the sand (not wet).**
4. **Heat the can thoroughly with the burner or torch. The can should get very hot.**
5. **When an area of sand is dry, fumarole activity should become evident. The students should take note of the action of steam on the sand particles and record their observations on the fumarole data sheet.**
6. **Make a well in another section of dry, hot sand. Drop an ice cube into it. The students should observe more intense fumarole activity. The description of this action should be included on the fumarole data sheet.**



DEMONSTRATION — FUMAROLE ACTIVITY

REFERENCES:

— "Quiet broken by new eruptions, more bulging," Page 11

BACKGROUND:

Shortly after the May 18 eruption, observers flying over the devastated area north of Mount St. Helens reported a large steam and ash eruption near the former south shore of Spirit Lake.

They observed the eruption was coming from a small crater. Some people speculated that the volcano had opened up a new vent.

Later observations by USGS scientists determined that some sizable steam eruptions were occurring in the area. However, these were fumaroles (steam eruptions); not true volcanic eruptions. These occur when ground water or melt-water from buried ice blocks seep into the superheated material from the volcano. The water turns to steam and explodes as a plume, sometimes carrying ash with it. The underground temperature in the ash flow at a depth of a few feet was measured as high as 330 degrees Celsius many days after the eruption. Small steam vents, or fumaroles, are expected to continue for some time.

PROCEDURE:

Record on the fumarole data sheet a description of the sand activity both with and without the ice cube.

STUDY QUESTIONS:

1. What is the cause of a fumarole?

Heated material from underground releases gases, including steam which rises through weak areas and is vented into the air.

2. What might cause fumaroles to be formed where volcanic ash flows cover a lake (Spirit Lake near Mount St. Helens)?

As water seeps into the pyroclastic flow material, steam is generated, sometimes creating spectacular eruptions.

3. When the ice cube was dropped in the sand well, the sand activity was greater. Why?

There is a greater temperature differential from surface (cold) to subsurface (hot). The water bubbles with the sand.

DESCRIPTION OF SAND

1. Hot sand	Answers vary
2. Ice cube in sand	Answers vary

NAME: _____ DATE: _____

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1. What is the cause of a fumarole?

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3. When the ice cube was dropped in the sand well, the sand activity was greater. Why?

DESCRIPTION OF SAND

1. Hot sand	
2. Ice cube in sand	

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LEVEL INFORMATION: SCI MS, HS

EARTHQUAKES — HERALD OF WHAT IS TO COME, BUT WHEN? . . .

OBJECTIVE:

The students will describe the lack of correlation between earthquakes and the May 18, 1980 eruption of Mount St. Helens, and how harmonic tremors are used to predict eruptions.

TEACHER BACKGROUND:

The article about Charlotte King may be included also, to provide a light touch to something scientists regard seriously.

EARTHQUAKES — HERALD OF WHAT IS TO COME, BUT WHEN? . . .

REFERENCE ARTICLES:

— "Two types of shakes," Page 9
— "Quakes imply lava is flowing," Page 9
— "St. Helens' tremors are weak," Page 9
— "Quake danger prompts mount St. Helens warning," Page 8
— "Scientists getting good at predictions," Page 6

MATERIALS:

Appendix VI, Earthquakes and other data from Mount St. Helens

INTRODUCTION:

Different kinds of seismic data will be plotted to see what relationships exist between earthquakes and eruptions. Do the patterns of seismic activity at Mount St. Helens between March 20 and May 18, 1980, give us any clues? Could you have predicted the major eruption of Mount St. Helens from the earthquakes? Will geologists be able to predict future eruptions of Mount St. Helens or other Cascade volcanoes?

PROCEDURE:

Four different questions will be considered:

Between March 20 and May 18, many small earthquakes occurred. These could not be felt but were recorded on seismographs. For example, on March 27, 135 earthquakes were recorded with a magnitude of 3.0 or greater. How do the number of small earthquakes relate to volcanic activity? Data on the total number of events are recorded in Column A of Table 1, as the average number of earthquakes per hour.

Plot the points of the average number of earthquakes per hour on the graph of Figure 1. Connect the points with a line. (Note that the data are averaged into groups of three days. Thus, you only have to plot about 20 points to represent about 60 days.)

2. Since earthquakes vary in intensity, perhaps the pattern of the strongest earthquakes may be significant. The actitvity of Mount St. Helens began with a 4.0 earthquake on March 20. A 5.1 earthquake on May 18 triggered the major eruption. Earthquakes of 5.0 intensity would be felt if you were close to the place of origin, but may not be felt if you were 30-40 miles away. These earthquakes were not generally felt by residents of the populated areas west of Mount St. Helens.

Plot the intensity of the largest earthquake on the graph of Figure 2. The strongest earthquake during a given 3-day period are listed in Column B, Table 1.

3. On some days, a large number of fairly strong earthquakes occurred. On May 10, 11 and 12, 10 earthquakes with an intensity greater than 4.0 were recorded. As such data might be important, the number earthquakes greater than 4.0 was recorded (Column B of Table 1).

Plot the number of earthquakes stronger than 4.0 on the graph of Figure 3.

4. Harmonic tremors are a special kind of earthquake that can be detected only by seismographs. These kinds of earthquakes are associated with upward movement of molten rock in the Hawaiian volcanoes. When harmonic tremors were identified as originating under Mount St. Helens, it was thought that molten rock (magma) might be moving. Therefore, scientists looked for a relationship between the harmonic tremors and eruptions.

Record the occurrence of harmonic tremors on any one of your graphs. You might do this with the letter "H". The date is given in Table 1.

5. Examine the data you have plotted. In the space below, write your conclusions on how you think earthquakes might be used to predict volcanoes.

a. Can you detect a relationship between average number of earthquakes per hour and the eruptions of Mount St. Helens? See Graph A.

The first eruption of Mt. St. Helens on March 27 correlates with a large number of earthquakes. However, after this date, the number gradually decreased, and no relationship seems to exist between acitvity and eruptions. This was disappointing because geologists thought that an impending major eruption could be predicted by increased earthquake activity.

b. Can you detect a relationship between the intensity of earthquakes and eruptions? See Graph B.

No. The intensity of the largest earthquakes varied between 4.0 and 5.0 without any obvious relationship to volcanic activity. The number of earthquakes greater than 4.0 reached maximums on about April 23 and May 11. However, these do not seem to relate to eruptions.

c. Can you detect a relationship between the volcanic activity and harmonic tremor?

No. It would seem that such a relationship should exist between the movement of molten rock and eruptions. However, it doesn't appear the harmonic tremors alone can be used as a prediction. Some molten material must move without producing harmonic tremors.

d. The volcano Kiluea in Hawaii can be monitored for eruptions using harmonic tremor data. Read the article "Scientists getting good at prediction," Page 6. How are harmonic tremors now being used to predict an eruption on Mount St. Helens?

An eruption always occurs after a harmonic tremor of at least a half hour.

e. What else is used to predict an eruption besides harmonic tremors, according to the article mentioned above?

Decrease in $CO_2 + SO_2$ output, causing pressure to build.

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ANSWER SHEET – GRAPHS OF EARTHQUAKE ACTIVITY

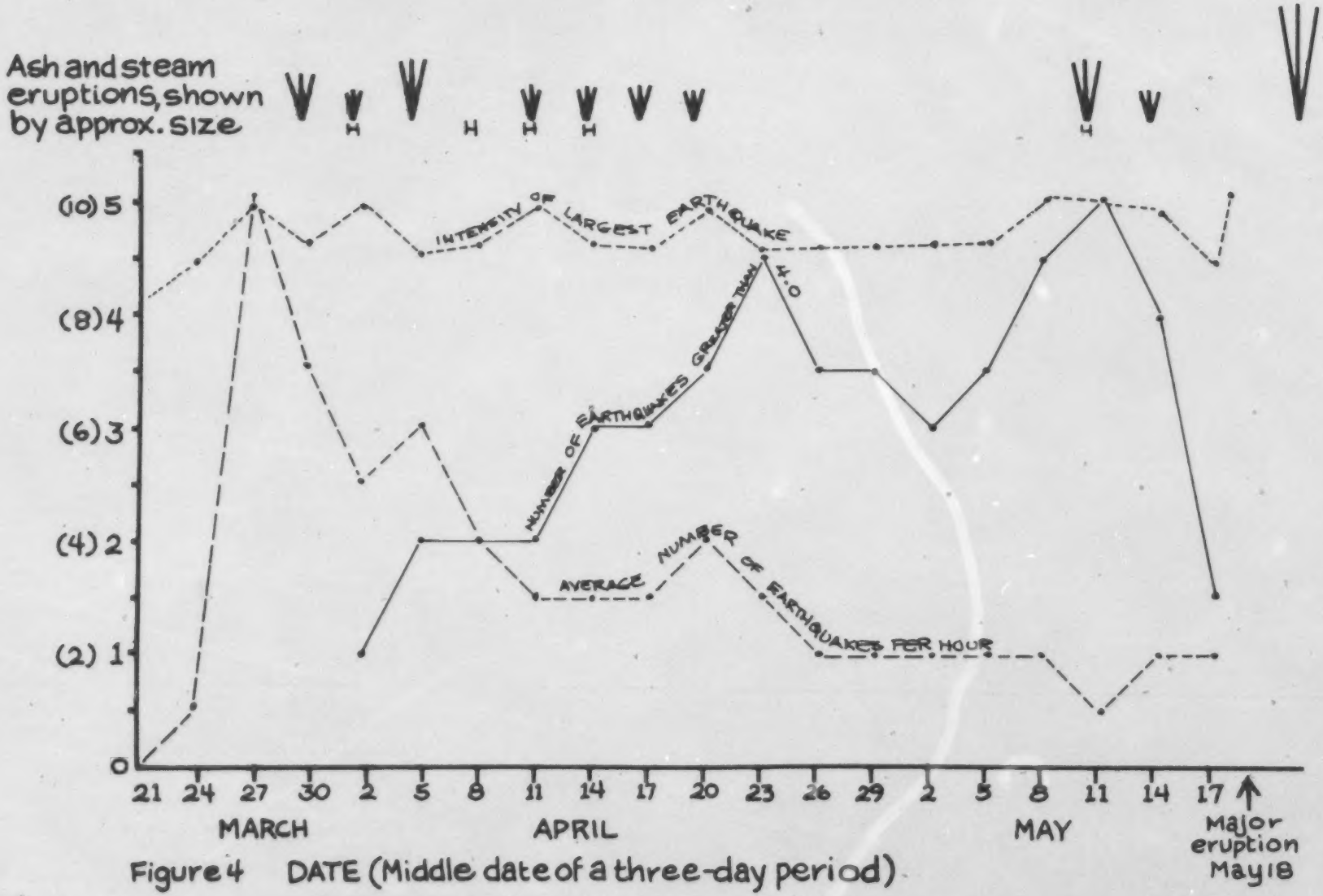
Ash and steam eruptions, shown by approx. size
(10) 5
(8) 4
(6) 3
(4) 2
(2) 1
0
INTENSITY OF LARGEST EARTHQUAKE
NUMBER OF EARTHQUAKES GREATER THAN 4.0
AVERAGE NUMBER OF EARTHQUAKES PER HOUR
21 24 27 30 2 5 8 11 14 17 20 23 26 29 2 5 8 11 14 17
MARCH
APRIL
MAY
Major eruption May 18
DATE (Middle date of a three-day period)

Figure 4

NAME: _____ DATE: _____

EARTHQUAKES — HERALD OF WHAT IS TO COME, BUT WHEN? . . .

REFERENCE ARTICLES:

— "Two types of shakes," Page 9
— "Quakes imply lava is flowing," Page 9
— "St. Helens' tremors are weak," Page 9
— "Quake danger prompts mount St. Helens warning," Page 8
— "Scientists getting good at predictions," Page 6

MATERIALS:

Appendix VI, Earthquakes and other data from Mount St. Helens

INTRODUCTION:

Different kinds of seismic data will be plotted to see what relationships exist between earthquakes and eruptions. Do the patterns of seismic activity at Mount St. Helens between March 20 and May 18, 1980, give us any clues? Could you have predicted the major eruption of Mount St. Helens from the earthquakes? Will geologists be able to predict future eruptions of Mount St. Helens or other Cascade volcanoes?

PROCEDURE:

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Between March 20 and May 18, many small earthquakes occurred. These could not be felt but were recorded on seismographs. For example, on March 27, 135 earthquakes were recorded with a magnitude of 3.0 or greater. How do the number of small earthquakes relate to volcanic activity? Data on the total number of events are recorded in Column A of Table 1, as the average number of earthquakes per hour.

Plot the points of the average number of earthquakes per hour on the graph of Figure 1. Connect the points with a line. (Note that the data are averaged into groups of three days. Thus, you only have to plot about 20 points to represent about 60 days.)

2. Since earthquakes vary in intensity, perhaps the pattern of the strongest earthquakes may be significant. The actitvity of Mount St. Helens began with a 4.0 earthquake on March 20. A 5.1 earthquake on May 18 triggered the major eruption. Earthquakes of 5.0 intensity would be felt if you were close to the place of origin, but may not be felt if you were 30-40 miles away. These earthquakes were not generally felt by residents of the populated areas west of Mount St. Helens.

Plot the intensity of the largest earthquake on the graph of Figure 2. The strongest earthquake during a given 3-day period are listed in Column B, Table 1.

3. On some days, a large number of fairly strong earthquakes occurred. On May 10, 11 and 12, 10 earthquakes with an intensity greater than 4.0 were recorded. As such data might be important, the number earthquakes greater than 4.0 was recorded (Column B of Table 1).

Plot the number of earthquakes stronger than 4.0 on the graph of Figure 3.

4. Harmonic tremors are a special kind of earthquake that can be detected only by seismographs. These kinds of earthquakes are associated with upward movement of molten rock in the Hawaiian volcanoes. When harmonic tremors were identified as originating under Mount St. Helens, it was thought that molten rock (magma) might be moving. Therefore, scientists looked for a relationship between the harmonic tremors and eruptions.

Record the occurrence of harmonic tremors on any one of your graphs. You might do this with the letter "H". The date is given in Table 1.

5. Examine the data you have plotted. In the space below, write your conclusions on how you think earthquakes might be used to predict volcanoes.

a. Can you detect a relationship between average number of earthquakes per hour and the eruptions of Mount St. Helens? See Graph A.

b. Can you detect a relationship between the intensity of earthquakes and eruptions? See Graph B.

c. Can you detect a relationship between the volcanic activity and harmonic tremor?

d. The volcano Kiluea in Hawaii can be monitored for eruptions using harmonic tremor data. Read the article "Scientists getting good at prediction," Page 6. How are harmonic tremors now being used to predict an eruption on Mount St. Helens?

e. What else is used to predict an eruption besides harmonic tremors, according to the article mentioned above?

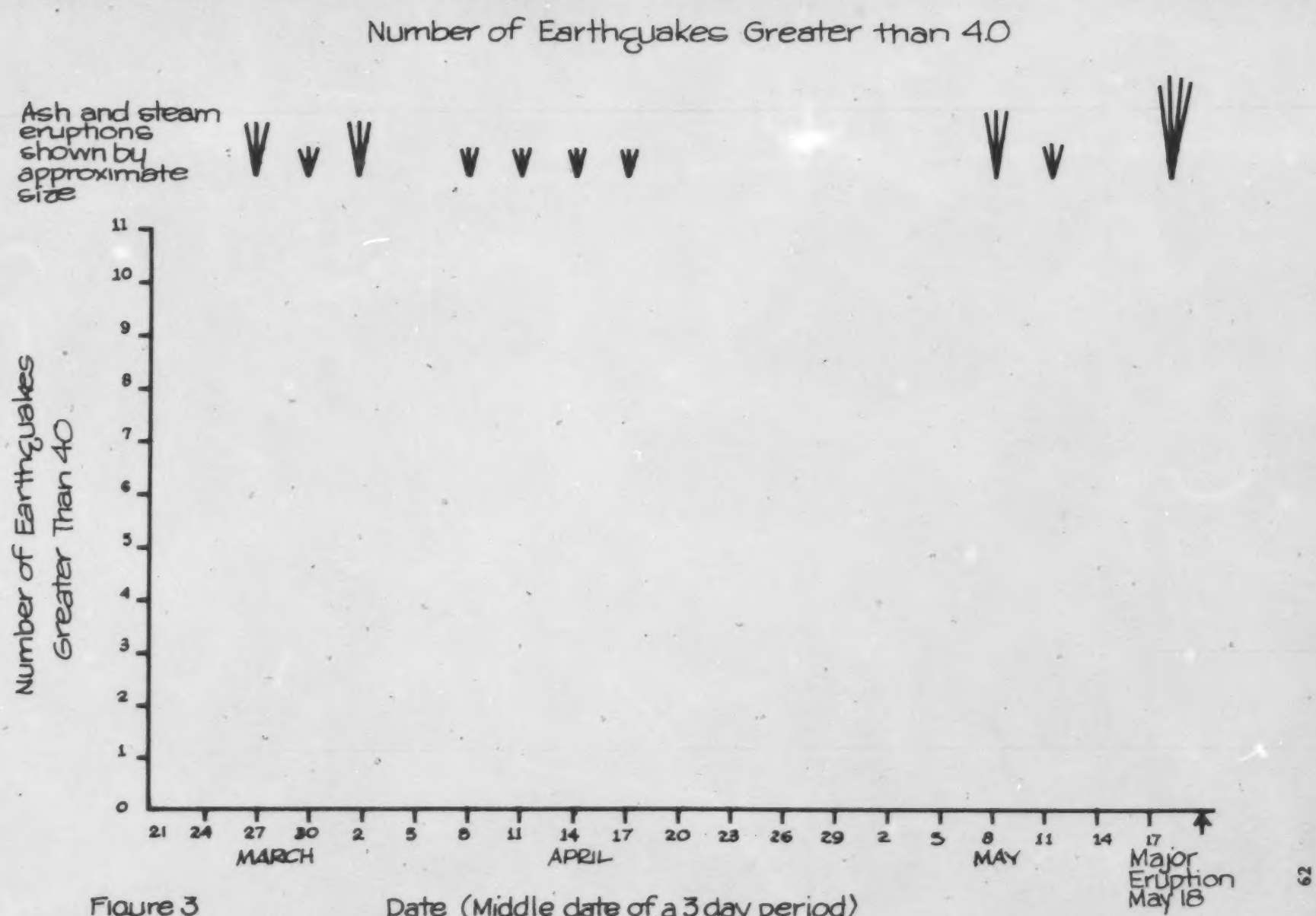

Number of Earthquakes Greater than 4.0
Ash and steam eruptions shown by approximate size
Number of Earthquakes Greater Than 4.0
0
1
2
3
4
5
6
7
8
9
10
11
21 24 27 30 2 5 8 11 14 17 20 23 26 29 2 5 8 11 14 17
MARCH
APRIL
MAY
Major Eruption May 18
Date (Middle date of a 3 day period)

Figure 3

STRONGEST EARTHQUAKES

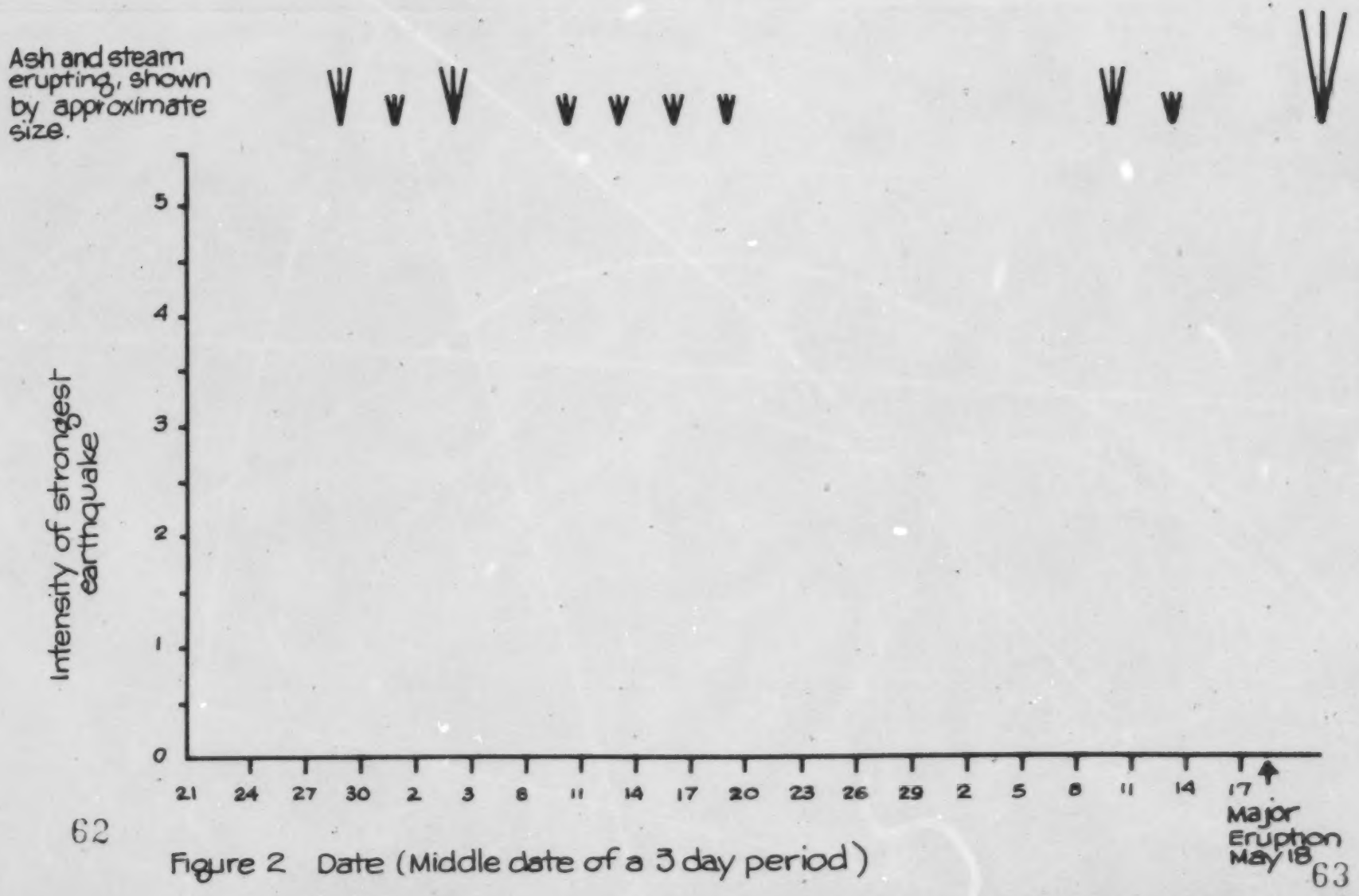
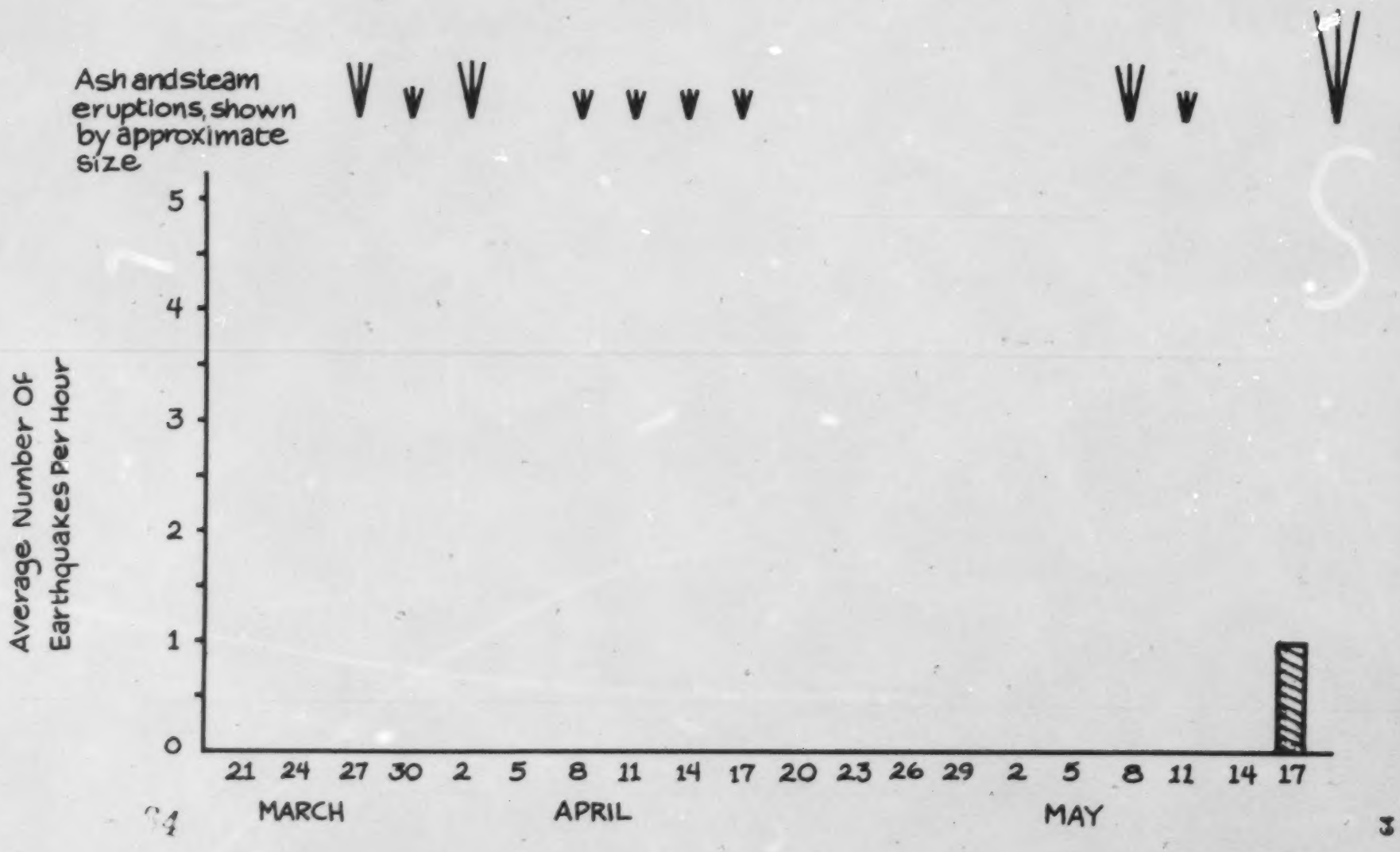


Figure 2 Date (Middle date of a 3 day period)


Average Earthquake Activity Per Hour
Ash and steam eruptions, shown by approximate size
Average Number Of Earthquakes Per Hour
5
4
3
2
1
0
21 24 27 30 2 5 8 11 14 17 20 23 26 29 2 5 8 11 14 17
MARCH
APRIL
MAY

LEVEL INFORMATION: SCI MS, HS

DEMONSTRATION: THERE'S NOTHING LIKE A WARM COLA

OBJECTIVES:
The students will:
1. **Observe and describe the effect heat has on the stability of a gas.**
2. **Compare a bottle of pop that has been shaken to Mount St. Helens.**

MATERIALS NEEDED:
Two unopened bottles of the same kind of pop.
Bottle opener.

TEACHING SUGGESTIONS:
Procedure:
1. **Refrigerate one bottle of pop. Put the other bottle of pop in a warm place. When you do this activity, it is important that the two bottles of pop are quite different in temperature.**
2. **Give the two bottles of pop to one student to shake vigorously. The student should hold them together. It is important that the amount of shaking is exactly the same.**
3. **Set the bottles on a table and select some brave student to open the bottles.**
4. **Before the bottles are opened, have the student record predictions. NOTE: This activity should probably be done outside.**

DEMONSTRATION: THERE'S NOTHING LIKE A WARM COLA

REFERENCE ARTICLES:
— "Nature uncorked a powerful bottle," Page 18
— Photomicrograph of Ash, Page 23

PROCEDURE:
1. Record your prediction about the demonstration below.

Answers vary

2. Observe the pop bottle demonstration.

3. Answer the following questions.

QUESTIONS:
1. What happened when the bottles were opened?

A mixture of gas and liquid erupted from the bottles. The bottle which was warm lost more liquid than the one which was cold.

2. Where was the gas before the bottles were opened?

It was in a liquid form as part of the pop. The CO_2 was present but not as a gas because it was contained within the confining space of the bottle.

3. Why did the gas rush out?

When the bottle was opened, the pressure was released. The liquid CO_2 changed to a gas, which occupied more space. Thus, the gas rushed out, carrying with it some of the liquid pop.

4. Do you think the amounts of CO_2 were different before the bottles were open?

No. The amount should have been the same.

5. Why did one bottle erupt more violently than the other?

The liquid is more stable in the colder liquid. At higher temperatures, the CO_2 has greater tendency to convert to a gas.

6. In terms of pressure, what causes a volcano to erupt?

The heat of the volcano causes the gas to be under great pressure. If a crack develops so that the pressure is released, a rapid expansion occurs and the gases escape as a violent eruption. The expanding gas may carry with it some molten rock and pieces of solid rock from the volcano walls.

7. Some violent volcanic eruptions are accompanied by much pumice. Pumice is a glassy rock with many holes which will float on water. How do you think the pumice forms?

In the eruption, molten rock is carried out. Because it contains expanding gas, it may become a froth. When it cools quickly, the result is a glassy rock full of holes.

8. Look at the photograph of the ash (Page 23) that has been magnified 200 times. Do you think gases were involved in the formation of this ash? Why?

Yes. Some of the ash is really very fine-grained pumice. You can see that it consists of many gas holes.

NAME: _____ DATE: _____

DEMONSTRATION: THERE'S NOTHING LIKE A WARM COLA

REFERENCE ARTICLES:
- "Nature uncorked a powerful bottle," Page 18
- Photomicrograph of Ash, Page 23

PROCEDURE:
1. Record your prediction about the demonstration below.
2. Observe the pop bottle demonstration.
3. Answer the following questions.

QUESTIONS:
1. What happened when the bottles were opened?

2. Where was the gas before the bottles were opened?

3. Why did the gas rush out?

4. Do you think the amounts of CO_2 were different before the bottles were open?

5. Why did one bottle erupt more violently than the other?

6. In terms of pressure, what causes a volcano to erupt?

7. Some violent volcanic eruptions are accompanied by much pumice. Pumice is a glassy rock with many holes which will float on water. How do you think the pumice forms?

8. Look at the photograph of the ash (Page 23) that has been magnified 200 times. Do you think gases were involved in the formation of this ash? Why?

LEVEL INFORMATION: SCI, MATH MS, HS

FIELDS AND FIELDS OF ASH

OBJECTIVES:
The students will:
1. **Given a map and grid overlay, determine the approximate area (in square miles) of the blowdown.**
2. **Calculate in familiar units the size of the blowdown area.**

TEACHING BACKGROUND
1. **The students will need some background in map reading, i.e. contour lines, scales, keys, etc. Football field dimensions are 50 x 120 yards (including end zones)**
2. **Have students do the topographic map activity to promote understanding of this skill.**
3. **Allow at least one half hour of class time so students can ask questions.**
4. **Thermofax several grids for student use.**

FIELDS AND FIELDS OF ASH

REFERENCES:
— "Searching: Helicopters comb 'hell on earth' to find survivors," Page 41.
— "Beautiful valley now desolate wasteland," Page 18.
— Sequence of events, page 16

MATERIALS:
Map of the zone of devastation.
Transparent grid overlay (each square equals one square mile)

PROCEDURE:
Read the reference articles.

1. Place grid of one-square-miles on map showing area of blast devastation (blowdown area.) Secure the grid with tape so it will not move after you start counting.

2. Count the number of squares of the grid that are completely within the blowdown area. If even the smallest part of the blowdown area lies outside the square, do not count it.
How many squares did you count?

The answer should be about 146 square miles. However, the answer will vary somewhat depending on the exact placement of the grid on the map.

3. Count the number of squares of the grid that are partly inside the blowdown area. All should be counted; some may be as much as 98 percent inside and some may be as little as 2 percent. Essentially, you are counting all the squares which include the boundary line. How many partial squares did you count?

The answer should be about 84 squares. Again, the answer will vary somewhat depending on the exact placement of the grid on the map.

4. Some partial squares are mostly inside the blowdown area whereas some include only a small part of the blowdown. How can you estimate the value in square miles of the blowdown area represented by the partial squares which you counted.

Assuming as much is inside the blowdown area as is outside of it, the average in all the squares should be 50 percent. Therefore, divide the total number of partial squares by 2 to obtain the number of square miles.

5. Add your values together. What was the total number of square miles of the blowdown area?

Answer should be about 188 square miles. Using the map published by the Washington State Department of Natural Resources, the number of square miles was found to be 186-188 square miles by a computer study.

6. How does your value compare to that published in the newspaper? How might this be explained?

One of the earlier values is given as 156 square miles, which seems to be too low. This was probably an early estimate before the exact boundaries of the blowdown area had been determined. However, it is likely that when the geologists study the area more carefully that a more precise value will be determined.

7. As it is sometimes difficult to visualize size, let's compare the size to that of a football field. How many football fields do you think would fit inside the blowdown area? (Make a guess).

Answers will vary.

8. One square mile could contain 516 football fields. Using the approximate value of 500, how many football fields would fit in the blowdown area?

94,000 football fields. If the value of 516 is used it would hold 97,008 football fields.

70

EXTENDED ACTIVITIES

1. If these football fields were laid end-to-end, how far would they stretch in miles? (About 15 football fields laid end-to-end would make up a mile.)

Answer is 6,266 miles based on 94,000 or 6,467 miles based on 97,008.

2. How far would this be in terms of the distance between New York City and San Francisco? (This distance is 2,566 miles.)

Answer is about 2½ times as far. The football fields would stretch from one city to the other and back again and halfway as a third trip.

3. The area of the state of Washington is approximately 68,200 square miles. What precentage of the state does the blowdown area represent?

188/68,200 equals 0.28 per cent
(Less than 3/10 of 1 per cent).

NAME: _____ DATE: _____

FIELDS AND FIELDS OF ASH

REFERENCES:
- "Searching: Helicopters comb 'hell on earth' to find survivors," Page 41.
- "Beautiful valley now desolate wasteland," Page 18.
- Sequence of events, page 16
- Map, page 31

MATERIALS:
Map of the zone of devastation.
Transparent grid overlay (each square equals one square mile)

PROCEDURE:
Read the reference articles.

1. Place grid of one-square-miles on map showing area of blast devastation (blowdown area.) Secure the grid with tape so it will not move after you start counting.

2. Count the number of squares of the grid that are completely within the blowdown area. If even the smallest part of the blowdown area lies outside the square, do not count it.
How many squares did you count?

3. Count the number of squares of the grid that are partly inside the blowdown area. All should be counted; some may be as much as 98 percent inside and some may be as little as 2 percent. Essentially, you are counting all the squares which include the boundary line. How many partial squares did you count?

4. Some partial squares are mostly inside the blowdown area whereas some include only a small part of the blowdown. How can you estimate the value in square miles of the blowdown area represented by the partial squares which you counted.

5. Add your values together. What was the total number of square miles of the blowdown area?

6. How does your value compare to that published in the newspaper? How might this be explained?

7. As it is sometimes difficult to visualize size, let's compare the size to that of a football field. How many football fields do you think would fit inside the blowdown area? (Make a guess).

8. One square mile could contain 516 football fields. Using the approximate value of 500, how many football fields would fit in the blowdown area?

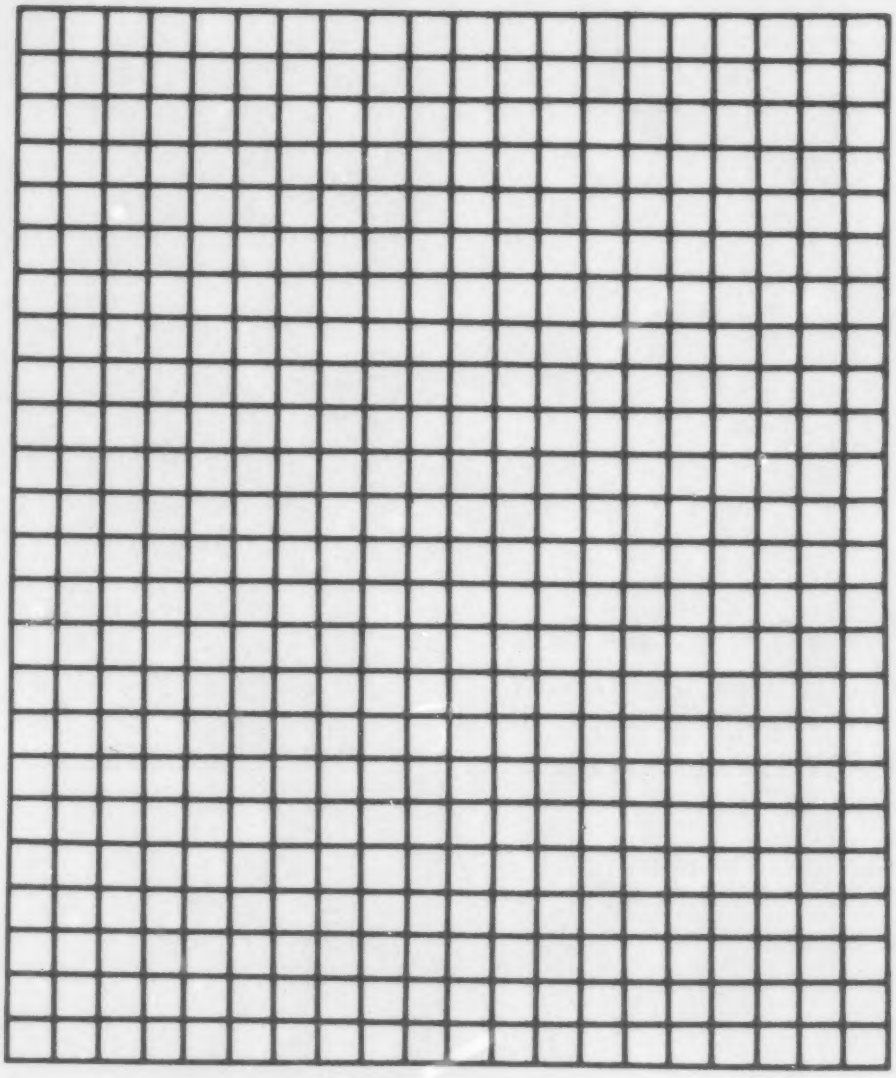
NAME: _____ DATE: _____

EXTENDED ACTIVITIES

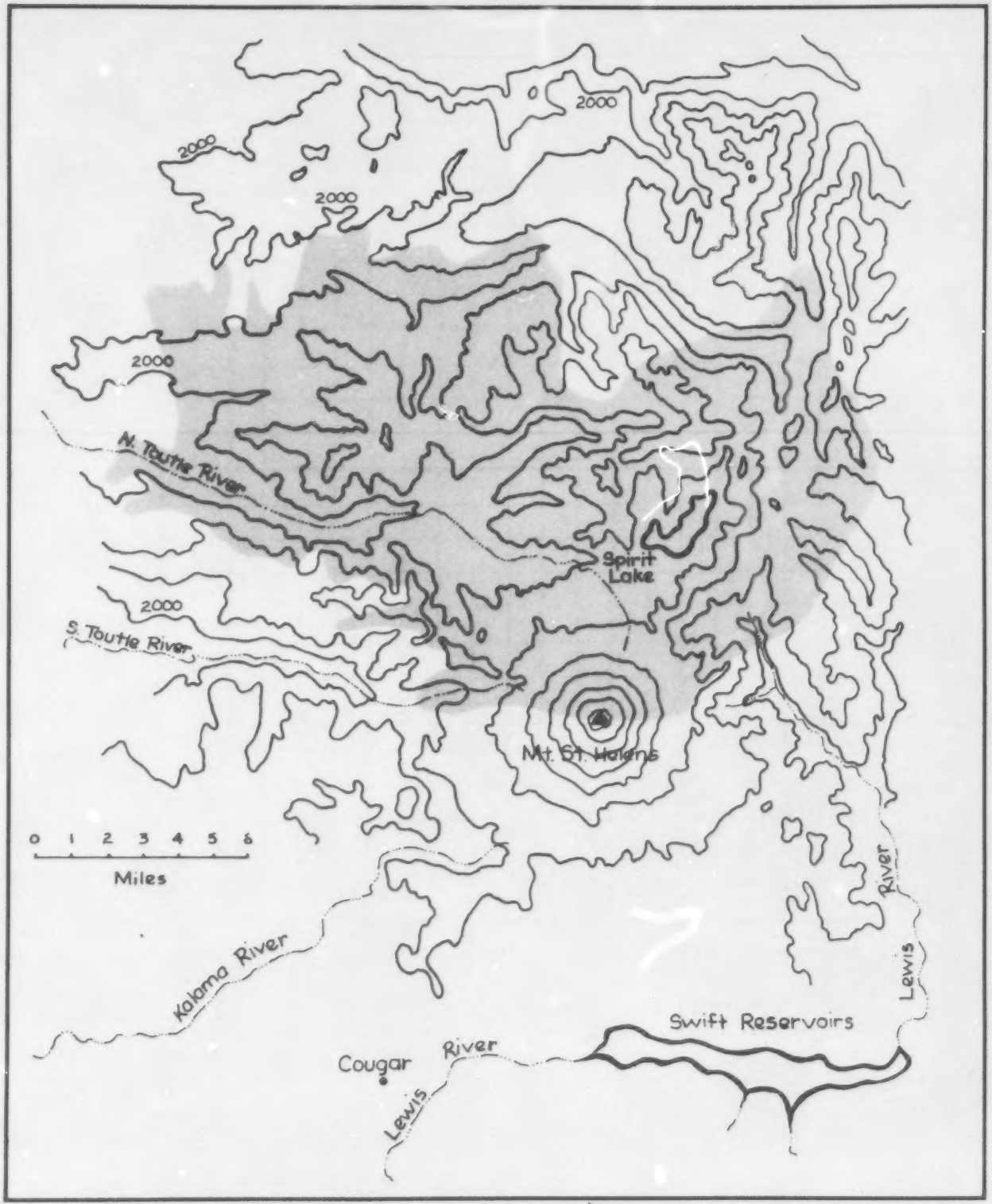
1. If these football fields were laid end-to-end, how far would they stretch in miles? (About 15 football fields laid end-to-end would make up a mile.)

2. How far would this be in terms of the distance between New York City and San Francisco? (This distance is 2,566 miles.)

3. The area of the state of Washington is approximately 68,200 square miles. What precentage of the state does the blowdown area represent?



GRID ¼" – 1 MILE
1 SQUARE - 1 SQUARE MILE


2000
2000
2000
2000
2000
N. Toutle River
S. Toutle River
Spirit Lake
Mt. St. Helens
0 1 2 3 4 5 6
Miles
Kalama River
Lewis River
Swift Reservoirs
Cougar
River
Lewis

LEVEL INFORMATION: SCI, SS MS, HS

MOVEMENT OF THE ASH CLOUD

OBJECTIVE:

The students will describe the movement of the ash cloud across the western United States.

TEACHING SUGGESTIONS:

1. **Discuss the articles and diagrams with the class.**
2. **Verbally quizzing the students on the patterns of ash fall will be helpful in promoting understanding.**
3. **Set aside at least an hour for this activity. This will allow you time to help students with their interpretation of the maps and diagrams.**

MOVEMENT OF THE ASH CLOUD

REFERENCE ARTICLES:

— Maps, Page 20.
— Satellite picture, Page 19.
— Prevailing Winds map, Page 19.
— "Trail of ash cuts gritty pathway across nation," Page 21.

PROCEDURE:

1. Read the introductory paragraph.
2. Study the drawings.
3. Answer the questions below.

INTRODUCTION:

The movement of the ash cloud from the May 18 eruption can be traced on satellite photographs. One such photograph is shown on Page 19. It was taken from the satellite called TIROS-N from 60,000 feet at 9:54 a.m. It shows that after 1 hour and 21 minutes, the cloud had spread to slightly beyond Yakima, WA. The billows of the cloud suggest that the cloud was formed by continuous eruptions of varying intensity.

The series of drawings on Page 20 is based on photographs taken by the satellite GOES West, (Geostationary Operational Environment Satellite.) The photographs may be obtained from NOAA.

QUESTIONS:

1. The position of the cloud at 8:45 a.m. shows the location of Mount St. Helens. In what direction did winds carry the ash during the next three hours?

East.

2. At approximately what time did the ash cloud pass over the state line between Washington and Idaho?

As the cloud was a considerable distance away at 11:15 a.m., and just a short distance over the line at 12:15 p.m., the time can be given as 12:15 p.m. or slightly before 12:15 p.m.

3. The eruption began at 8:32 a.m. How long did it take the ash to travel across the state of Washington?

Something less than 3 hours 43 minutes

4. What is the distance between Mount St. Helens and the eastern border of Washington? (Find a map to measure this distance.)

About 400 kilometers or 250 miles.

5. If you were in central Washington and saw the cloud of ash approaching from the west, how fast would you have to drive a car eastward to outrun the ash? (Determine the speed of the cloud from your answers to questions 3 and 4. You may use 3½ hours as the time.)

The cloud was traveling at about 114 km/hr or 71 mi/hr. You would have difficulty out-running the ash cloud.

6. How long did it take the ash cloud to reach New Mexico?

24 hours. It was there by 8:45 a.m. May 19, 1980.

7. What do you suppose were the differences in the kind and amount of ash which fell in Washington, Colorado and Montana?

The ash was progressively finer and less thick away from Mount St. Helens. The ash that fell in Washington was the coarsest and thickest. The ash falling in Colorado was very fine-grained and in very small amounts. That falling in Montana was also fine-grained. It was less thick than in Washington, but in greater amounts than in Colorado.

8. As shown in the sketches, what is the difference in the size of the ash clouds between May 18 at 11:15 a.m. and May 19 at 11:15 a.m.?

The cloud covered a smaller area on May 18. It covered a larger area on May 19.

9. What caused this difference in size?

By the second day (May 19) the wind and air currents had dispersed the cloud so it was thin and tenuous.

10. Because the cloud was bigger, do you think that more ash was in the cloud on May 19 than May 18? Why?

No. The cloud in May was very dense. By May 19 the coarser material had fallen out of the cloud. Only the finer material was being carried by the wind high in the atmosphere.

11. Very little ash fell in Michigan, which is directly east of Mount St. Helens. On the other hand, some fell in Arkansas, which is considerably to the south. What caused this odd distribution of ash (See maps on Page 20)?

The distribution was controlled by the winds of May 18-20. The winds high in the atmosphere took the curved path as shown on the map.
The direction of the prevailing winds in Western Washington is shown in the diagram on Page 19.

12. In which direction would the wind need to blow for ash from Mount St. Helens to fall on Seattle?

The wind would have to blow from south to north.

13. How likely is it that the winds would be blowing in this direction at the time of an eruption?

The prevailing winds are from the south only about 9 percent of the time during June. Thus, it is unlikely that Seattle would receive ash. The chances are less than 1 in 10.

14. Why were the cities of Longview and Kelso considered to be safe from ash fall?

The June-August winds blow in their direction from Mount St. Helens only 2 percent of the time.

15. What directions from Mount St. Helens would you predict would receive the most ash?

The winds blow mostly from the west toward the east. They are from the west 20% of the time; from the northwest 23% of the time; and from the southwest 28% of the time. Thus, the direction the ash cloud moved after the May 18 eruption was the direction that would have been predicted.

NAME:_____ DATE:_____

MOVEMENT OF THE ASH CLOUD

REFERENCE ARTICLES:

— Maps, Page 20.
— Satellite picture, Page 19.
— Prevailing winds map, Page 19.
— "Trail of ash cuts gritty pathway across nation," Page 21.

PROCEDURE:

1. Read the introductory paragraph.
2. Study the drawings.
3. Answer the questions below.

INTRODUCTION:

The movement of the ash cloud from the May 18 eruption can be traced on satellite photographs. One such photograph is shown on Page 19. It was taken from the satellite called TIROS-N from 60,000 feet at 9:54 a.m. It shows that after 1 hour and 21 minutes, the cloud had spread to slightly beyond Yakima, WA. The billows of the cloud suggest that the cloud was formed by continuous eruptions of varying intensity.

The series of drawings on Pages 20 is based on photographs taken by the satellite GOES West, (Geostationary Operational Environment Satellite.) The photographs may be obtained from NOAA.

QUESTIONS:

1. The position of the cloud at 8:45 a.m. shows the location of Mount St. Helens. In what direction did winds carry the ash during the next three hours?

2. At approximately what time did the ash cloud pass over the state line between Washington and Idaho?

3. The eruption began at 8:32 a.m. How long did it take the ash to travel across the state of Washington?

4. What is the distance between Mount St. Helens and the eastern border of Washington? (Find a map to measure this distance.)

5. If you were in central Washington and saw the cloud of ash approaching from the west, how fast would you have to drive a car eastward to outrun the ash? (Determine the speed of the cloud from your answers to questions 3 and 4. You may use 3½ hours as the time.)

6. How long did it take the ash cloud to reach New Mexico?

7. What do you suppose were the differences in the kind and amount of ash which fell in Washington, Colorado and Montana?

8. As shown in the sketches, what is the difference in the size of the ash clouds between May 18 at 11:15 a.m. and May 19 at 11:15 a.m.?

9. What caused this difference in size?

10. Because the cloud was bigger, do you think that more ash was in the cloud on May 19 than May 18?

Why?

11. Very little ash fell in Michigan, which is directly east of Mount St. Helens. On the other hand, some fell in Arkansas, which is considerably to the south. What caused this odd distribution of ash (See maps on Page 20)?

12. In which direction would the wind need to blow for ash from Mount St. Helens to fall on Seattle?

13. How likely is it that the winds would be blowing in this direction at the time of an eruption?

14. Why were the cities of Longview and Kelso considered to be safe from ash fall?

15. What directions from Mount St. Helens would you predict would receive the most ash?

LEVEL INFORMATION: SCI, MATH MS, HS

ASHES KEEP FALLING ON MY HEAD

OBJECTIVES:
The student will:
1. Given a map, determine the amount of ash that fell on Washington.
2. Develop possible explanations for the distribution of the ash fallout.
3. Obtain an understanding of the quantity by calculating the length of a road which might be constructed from this ash.

TEACHER BACKGROUND
Students need to understand how drawing lines based on ash thickness results in a "contour-like" map. They need to understand that the area between two lines may be given as an average, but this is only approximate. Such an average assumes that the thickness of the ash uniformly increases from one line to the next. This may not be the case. For example, in the area labeled as 10 mm, this average would not be correct if the amount of land covered by 5½ mm of ash were larger than the amount covered by 14½ mm of ash.

ASHES KEEP FALLING ON MY HEAD

REFERENCE ARTICLES:
— Color map, Page 27
— "Ash Cloud Reaching Across Nation, Page 21
— Maps, Page 20
— Prevailing winds map, Page 19

MATERIALS:
Paper and pencil
Calculator (optional)

ACTIVITY I — DISTRIBUTION

Read the articles about the ash fall and study the map showing the thickness of ash resulting from the May 18, 1980, eruption of Mount St. Helens. Answer the questions.

STUDY QUESTIONS:
1. What do you see as the most surprising fact about the distribution of the ash? How do the amounts vary?

The greatest amounts of ash fell near Ritzville, Wash. There, the average thickness was 60 millimetres. Another area of thick ash fall is found near Mount St. Helens. Here the ash fall averaged 50 millimetres. The surprising fact is that in the area between Yakima and Ellensburg on the direct path of the ash cloud, only 20 millimetres of ash fell. Lesser amounts of ash fell away from the path of the main cloud.

2. Using ash distribution as your basis, describe the direction of the winds carrying the ash.

At the beginning the winds carried the ash northeast. The winds shifted to the eastward. Near Moses Lake, Wash., the winds were blowing directly from west to east.

3. Suppose you were collecting date in the field. How would you go about deciding whether a given place had a "trace" or "zero" ash fall? What does this tell you about this line on the map?

It would be very difficult to distinguish between "trace" and "zero". For this reason the line marked "trace" should be considered only as an approximate location.

4. In general what do you think determines the accuracy of the map on Page 26. Remember how the lines are determined.

The accuracy would be determined by the number of points for which information was obtained. Exact information is probably missing from thinly populated areas.

5. The map is preliminary. The number of sample points was probably too small. If this is true, what use can be made of the map?

It should be used to show trends and to reach tentative conclusions. It can be used to show approximate positions of lines and exact size of areas.

6. Look at the area just northeast of Mount St. Helens. Do you think that the data are complete? Why?

The data probably are not complete. One would expect that northeast of the base of the mountain the amount of ashfall would be greater than 50 mm. Because the area was still quite inaccessible when the map was made, probably enough data were not collected. However, the area of heaviest ashfall near the mountain might be too small to show at the scale of this map.

7. It is not known exactly why the ashfall between Ellensburg and Yakima was less than at Ritzville. Can you think of any explanations?

The simplest explanation would be that the winds in the Ellensburg-Yakima area were very strong and most of the ash was carried past the area. By the time the winds reached Ritzville, they had slowed down ash to settle out in greater quantities.

Another explanation may be related to air temperature. Hot air can carry more ash than cold air. By the time the cloud had reached Ritzville it may have cooled down so that more ash was deposited.

A third explanation involves the sizes of the ash particles which were erupted. In general, the coarest material is deposited near the volcano and the finest material is deposited farther away. Graduations of ash occur in between. If the erupted ash consisted mainly of a mixture of coarse material and fine material with lesser amounts of material of intermediate size, the amount of ash fall would show this distribution. The coarsest material would fall near Mount St. Helens; the finer material would fall abundantly farther away; an area of lesser ashfall would occur between these areas simply because the cloud was not carrying as much ash of the intermediate size.

ACTIVITY II — VOLUME OF ASH

The total area of ashfall in Washington for the May 18 eruption has been calculated as being 82,500km². This is the size of the area inside the line marked "trace" on the ashfall distritution map.

STUDY QUESTIONS:

1. What percentage of the state of Washington had ashfall from the May 18 eruption? (Use 176,000km² as the size of Washington.)

47 percent — 82,500/176,600
46.7 percent

2. Because a trace of ash is not significant, let's calculate what percentage of the state received more than 5mm of ash. The size of this area is about 54,500km². What answer did you get?

31 percent — 54,500/176,600 = 30.8 percent

3. The chart below gives the sizes of the areas that received various amounts of ash from the May 18 eruption. Complete the last two columns of the chart to determine the volume of ash in cubic kilometres. As a review, metric units are given below:

Metric units

1 kilometre =	1,000 metres	1 metre =	.001 kilometre
1 kilometre =	100,000 centimetres	1 centimetre =	.0001 kilometre
1 kilometre =	1,000,000 millimetres	1 millimetre =	.000001 kilometre

Average amount of ash	Size of area	Amount of ash (kilometres)	Calculated volume of ash (cubic kilometres)
2 mm	28,000 km²	.000 002 km	.056 km³
10 mm	25,000 km²	.000 01 km	.250 km³
20 mm	11,500 km²	.000 02 km	.230 km³
30 mm	6,500 km²	.000 03 km	.195 km³
40 mm	5,500 km²	.000 04 km	.220 km³
50 mm	4,500 km²	.000 05 km	.225 km³
60 mm	1,500 km²	.000 06 km	.090 km³

4. What is the total volume of ash in cubic kilometres that fell on the state of Washington from the May 18 eruption? (Add the volumes obtained in the last column of the chart to obtain the total.)

1.266km³ or rounded off to 1.3km³

5. If you constructed a road with the ash that fell on Washington, how long would this road be in kilometres? Assume that the road will be 10 metre wide and 0.1 metre thick (10 centimetres). Use 1,300,000,000m³ as the amount of ash.

1,300,000 km
Each kilometre of road would require 1,000m³ of ash.
(1,000m x 10m x 0.1m = 1,000m³)
1,300,000,000 divided by 1,000 = 1,300,000km

6. If the distance from San Francisco to New York City is approximately 4000 km, how many roads could be built between these two cities with this ash?

325 roads (1,300,000 divided by 4,000 = 325)

7. If the circumference of the earth is about 40,000 km, how far would the road extend around the equator?

about 32 times (1,300,000 divided by 40,000 = 32.5

8. Some of the newspapers and scientific reports state that the amount of material erupted from Mount St. Helens on May 18 was one cubic kilometres. In this activity the calculations give the amount as 1.3 cubic kilometres. What reason can you think of for this difference in values?

The measurements of the thickness of the ash fall were too few so that the lines and averages are only approximate. When more facts are gathered the sizes of the area may be slightly different.

The measurement of ash thickness did not consider the "packing." Some of the ash further from the mountain was quite fluffy. Ash which was measured to be 45 mm thick in the Ritzville area might actually be less thick if it were compacted. The ash which fell nearer to the volcano and measured 45 mm thick was much coarser in size. The 45 mm there might represent more material than the 45 mm at Ritzville because the particles were more closely packed together.

9. People have wondered what to do with all the ash. What do you think will happen to it?

Some of the finer ash will be carried away by winds. Some will be carried away by running water and will be deposited as silt and sand in rivers or the ocean. Much of it in Central Washington will be deposited behind the dams on the Columbia River. Most of it, however, will become part of the soil.

NAME: _____ DATE: _____

ASHES KEEP FALLING ON MY HEAD

REFERENCE ARTICLES:
- Color map, Page 27
- "Ash Cloud Reaching Across Nation, Page 21
- Maps, Page 20
- Prevailing winds map, Page 19

MATERIALS:
Paper and pencil
Calculator (optional)

ACTIVITY I — DISTRIBUTION

Read the articles about the ash fall and study the map showing the thickness of ash resulting from the May 18, 1980, eruption of Mount St. Helens. Answer the questions.

STUDY QUESTIONS:

1. What do you see as the most surprising fact about the distribution of the ash? How do the amounts vary?

2. Using ash distribution as your basis, describe the direction of the winds carrying the ash.

3. Suppose you were collecting date in the field. How would you go about deciding whether a given place had a "trace" or "zero" ash fall? What does this tell you about this line on the map?

4. In general what do you think determines the accuracy of the map on Page 26. Remember how the lines are determined.

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6. Look at the area just northeast of Mount St. Helens. Do you think that the data are complete? Why?

7. It is not known exactly why the ashfall between Ellensburg and Yakima was less than at Ritzville. Can you think of any explanations?

NAME: _____ DATE: _____

ACTIVITY II — VOLUME OF ASH

The total area of ashfall in Washington for the May 18 eruption has been calculated as being 82,500km². This is the size of the area inside the line marked "trace" on the ashfall distritution map.

STUDY QUESTIONS:

1. What percentage of the state of Washington had ashfall from the May 18 eruption? (Use 176,000km² as the size of Washington.)

2. Because a trace of ash is not significant, let's calculate what percentage of the state received more than 5mm of ash. The size of this area is about 54,500km². What answer did you get?

3. The chart below gives the sizes of the areas that received various amounts of ash from the May 18 eruption. Complete the last two columns of the chart to determine the volume of ash in cubic kilometres. As a review, metric units are given below:

Metric units

1 kilometre =	1,000 metres	1 metre =	.001 kilometre
1 kilometre =	100,000 centimetres	1 centimetre =	.0001 kilometre
1 kilometre =	1,000,000 millimetres	1 millimetre =	.000001 kilometre

Average amount of ash	Size of area	Amount of ash (kilometres)	Calculated volume of ash (cubic kilometres)
2 mm	28,000 km²		
10 mm	25,000 km²		
20 mm	11,500 km²		
30 mm	6,500 km²		
40 mm	5,500 km²		
50 mm	4,500 km²		
60 mm	1,500 km²		

4. What is the total volume of ash in cubic kilometres that fell on the state of Washington from the May 18 eruption? (Add the volumes obtained in the last column of the chart to obtain the total.)

5. If you constructed a road with the ash that fell on Washington, how long would this road be in kilometres? Assume that the road will be 10 metre wide and 0.1 metre thick (10 centimetres). Use 1,300,000,000m³ as the amount of ash.

6. If the distance from San Francisco to New York City is approximately 4,000km, how many roads could be built between these two cities with this ash?

7. If the circumference of the earth is about 40,000km, how far would the road extend around the equator?

8. Some of the newspapers and scientific reports state that the amount of material erupted from Mount St. Helens on May 18 was one cubic kilometre. In this activity the calculations give the amount as 1.3 cubic kilometres. What reason can you think of for this difference in values?

9. People have wondered what to do with all the ash. What do you think will happen to it?

LEVEL INFORMATION: SCI, MATH MS, HS

BLAST AWAY!

OBJECTIVES:
The students will:
1. Compare the amount of displaced material in the Mount St. Helens eruption with other eruptions throughout history.
2. Produce graphs about the displaced material.
3. Calculate comparative values of displaced materials.
4. Compare the size of the eruption with human losses.

TEACHING SUGGESTIONS:
1. Ask the students to read the reference articles in "Mount St. Helens."
2. Discuss with the class the eruptions of several of the volcanoes listed.
3. Ask the students to do the listed activity. (You may have to review graphing and some of the calculations with them.) Also, review the use of a compass and protractor.
4. Have copies of "Fire and Ice" available for your reference and student use.
5. Before starting activity I, part C, the students should locate Tambora, Krakatoa, Pelee and Mount St. Helens on a map or globe. Also, try to locate St. Pierre on an old map.

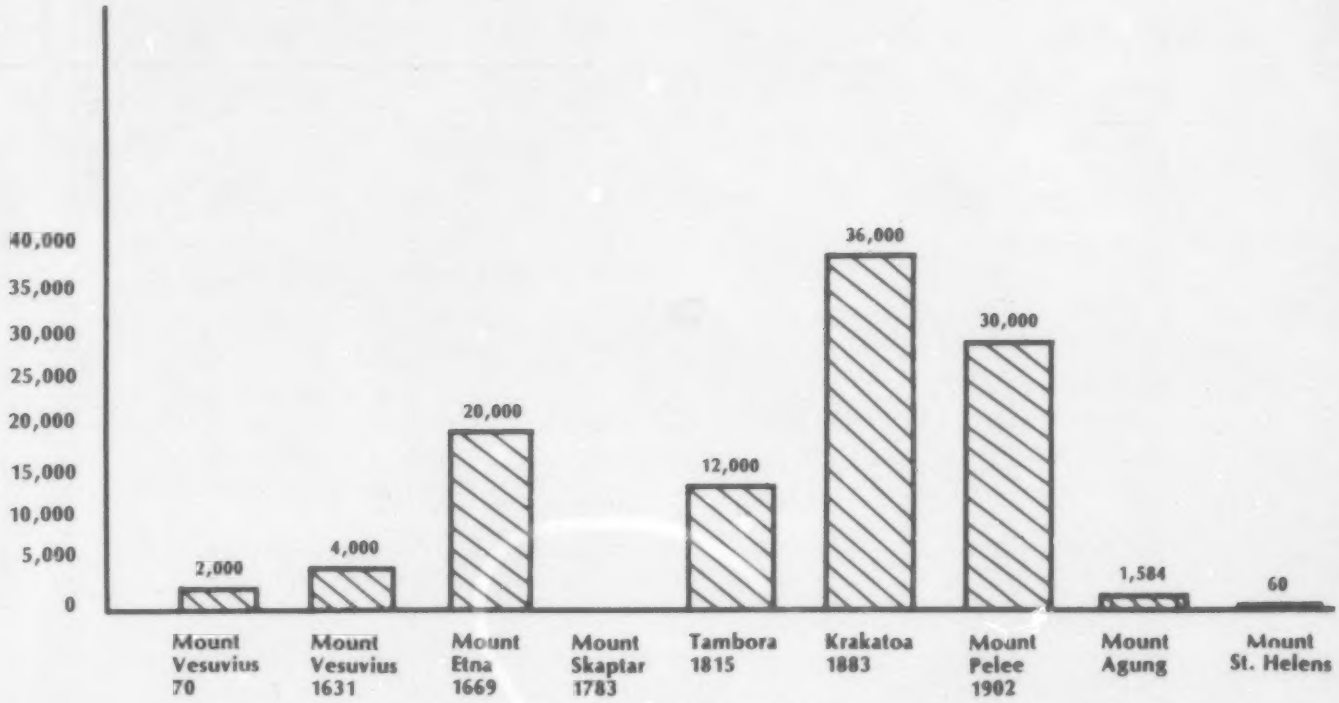
BLAST AWAY!
ACTIVITY I — RECORDING HUMAN LOSS

REFERENCE ARTICLES:
— "Eruptions in past have killed many," p. 36

PROCEDURE:
1. After reading the article "Eruptions in past have killed many," put the number of people killed by each eruption in the space provided.

Mount Vesuvius	AD 79	2,000
Mount Vesuvius	1631	4,000
Mount Etna	1669	20,000
Mount Skaptar	1783	--,---
Tambora	1815	12,000
Krakatoa	1883	36,000
Mount Pelee	1902	30,000
Mount Agung	1963	1,584
Mount St. Helens	1980	60

2. Construct a bar graph, using activity sheet I to record the deaths.



ACTIVITY SHEET I

ACTIVITY II — DISPLACED MATERIAL

1. The amount of material that comes out of a volcano is called "displaced material." Some volcanoes erupt more material than others. Mount St. Helens lost about one square kilometre of material. This material took the form of hot rock and ash which would make a road 10 m wide and 10 cm thick that would go around the world over 32 times.

2. Notice the difference in amounts of material lost by volcanoes shown below.
   a. Which volcano lost the most?

Tambora

   b. Which volcano lost the least?

Pelee

3. Make a bar graph of the displaced material on the activity II worksheet.

VOLCANO (DATE)	DISPLACED MATERIAL Volume in cubic kilometres
Mazama (4600 BC)	40
St. Helens (1900 BC)	3.3
Vesuvius (79)	2.7
Hekla (1104)	2.0
Fuji (1500)	1.3
St. Helens (1707)	0.9
Tambora (1815)	80
Krakatoa (1883)	20
Pelee (1902)	0.3
Katmai (1912)	30
St. Helens (1980)	1.0

ACTIVITY SHEET II

90

91

92

ACTIVITY III — COMBINATION OF MATERIAL DISPLACED AND HUMAN LOSS

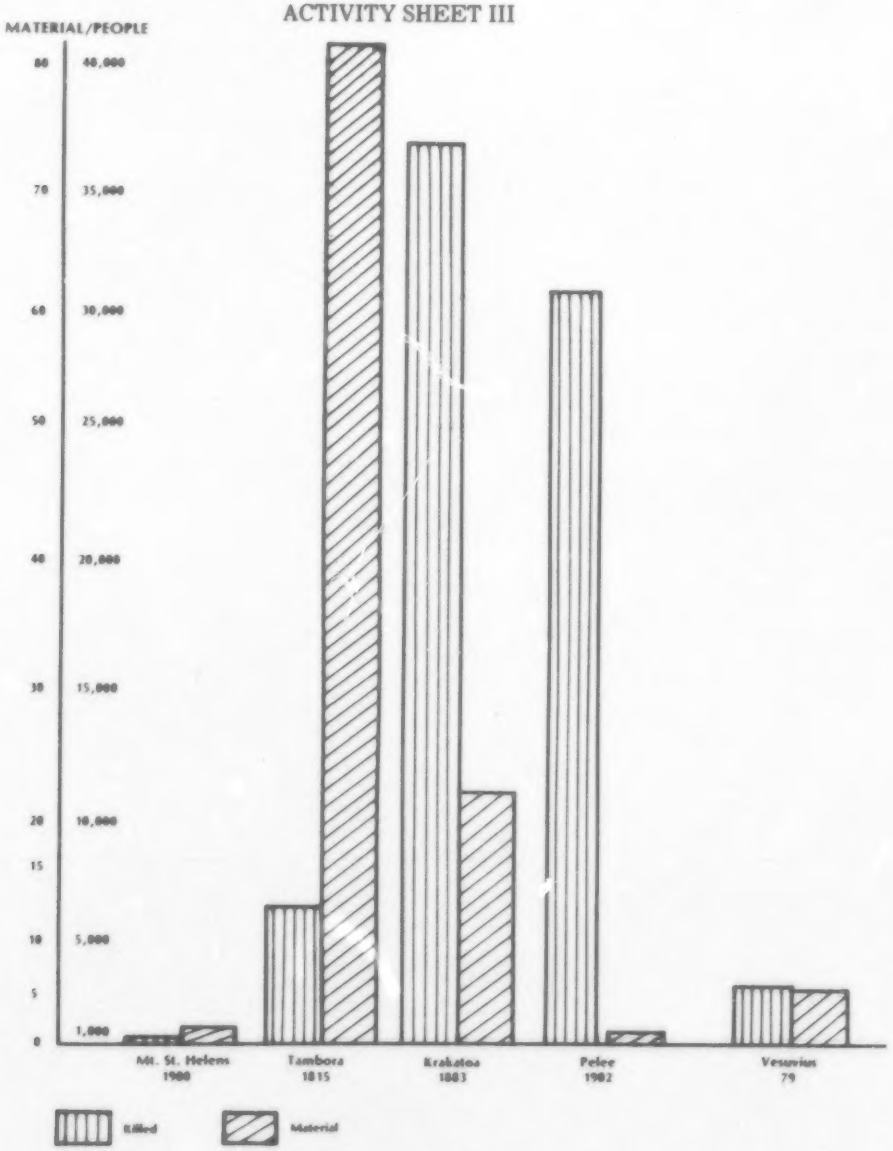
Some of the volcanoes have a record of the number of people killed and amount of displaced material erupted. They are Tambora, Krakatoa, Pelee and the Vesuvius eruption of 79 A.D.

1. In the table below, fill in the number of people killed and amount of displaced material for each volcano.

Volcano	Death toll	Displaced material
Vesuvius	2,000	2.7
Tambora	12,000	80
Krakatoa	36,000	20
Pelee	30,000	0.2
St. Helens	60	1.0

2. Make one more bar graph. This time, plot both the people killed and displaced material side by side on activity sheet III. St. Helens is done for you. Use either the shading used in the example or two different colors of crayon or pen.

ACTIVITY SHEET III



1. As you study the graph on activity sheet III, does it appear that the bigger the eruption, the more people will be killed? Which volcanoes make you think so, and why?

Pelee. It has the smallest displaced material, but second greatest casualty figure. And Mount St. Helens has a displaced rate greater than Pelee but has the fewest killed.

2. Tambora and Krakatoa are both islands. Yet Tambora had far fewer deaths. What are some possible explanations?

Krakatoa was a stronger eruption. More people may have lived on Krakatoa. More people may have lived closer to the volcano.

3. Krakatoa and Pelee killed almost the same number of people, even though Pelee's eruption was not nearly as strong. Why were so many killed by Pelee?

The city of St. Pierre was very close.

MATERIALS:
Protractor

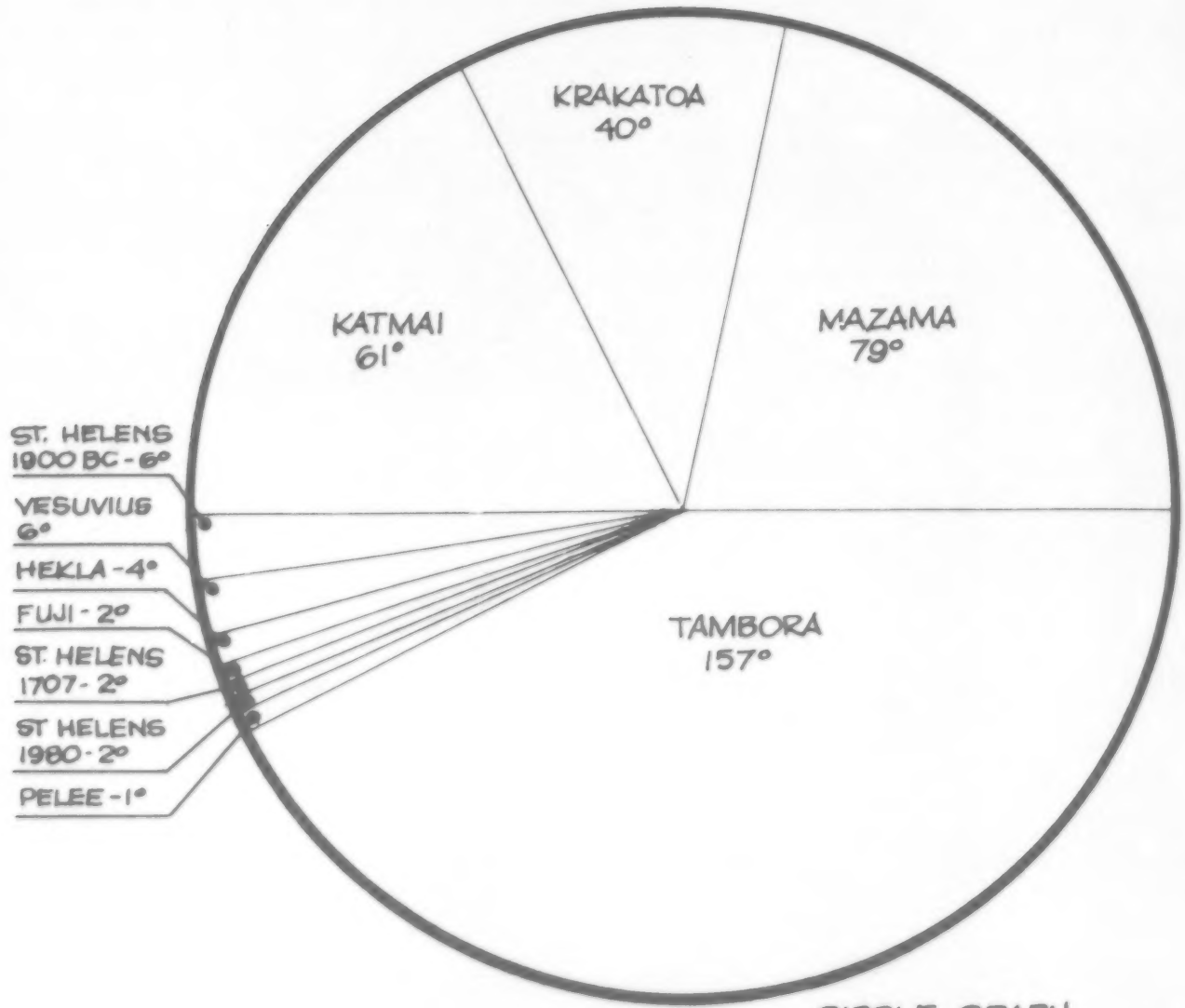
PROCEDURE:

1. Using the information in the chart "Volume of Volcano Displacement" activity sheet II, use the protractor to construct a circle graph to determine the location of the pie-shaped sections on the graph. Do not try to make the smaller amounts perfect. (Suggestions: Your measurements should be based on the degrees of circle.)

VOLUME OF VOLCANO DISPLACEMENT

(Total Displaced Volume of All Volcanoes + 180.3 cubic km.)

Volcano	Percent of Total	Degrees of Circle
Mazama	22	79 decrees
St. Helens 1900 B.C.	1.7	6 degrees
Vesuvius	1.5	6 degrees
Hekla	1.1	4 degrees
Fuji	.7	2 degrees
St. Helens 1707	.5	2 degrees
Tambora	44	157 degrees
Krakatoa	11	40 degrees
Pelee	.2	1 degree
Katmai	17	61 degrees
St. Helens 1980	.6	2 degrees



CIRCLE GRAPH

EXTENDED ACTIVITY — VOLCANIC HIGHWAY

MATERIALS:
Pencil and paper

PROCEDURE:
Answer the questions below. Base your answers on the following information:
1 cubic kilometre was ejected by Mount St. Helens in 1980. (1 cubic kilometre 1,000m X 1,000m X 1,000m)

QUESTIONS:
1. If you used the material ejected in 1980 from Mount St. Helens to build a road 10m wide by 10cm thick, how long would the road be?

1 cubic kilometre — 1,000m X 1,000m X 1,000m
1,000,000,000 cubic metres

Road section — 1 kilometre X 10m X 10cm
1,000m X 10m X .1m
1,000 cubic m/cm

Total length — 1,000,000,000 cubic metres

1,000 cubic m/cm

1,000,000 kilometres

2. How long would the same road be if the material ejected by Mount Tambora was used?

Since Tambora blew out 80 times as much material as Mount St. Helens the road would be 80,000,000 kilometres long.

3. Compare this to the distance from Seattle to Washington D.C.

Seattle to Washington, D.C., is 3,615.87km.
St. Helens road is 1,000,000 km.
St. Helens road is 276 times as long (276.56).

NAME: _____ DATE: _____

BLAST AWAY!
ACTIVITY I — RECORDING HUMAN LOSS

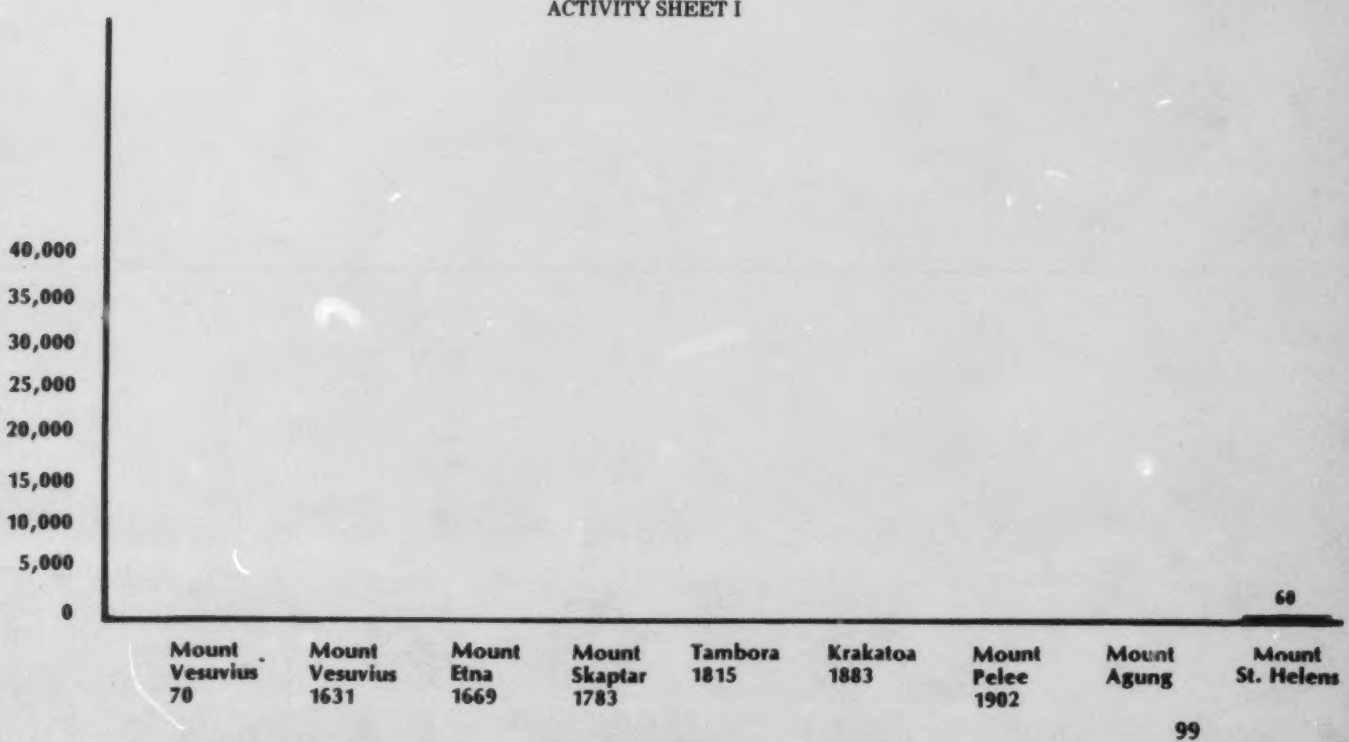
REFERENCE ARTICLES:
— "Eruptions in past have killed many," p. 36

PROCEDURE:
1. After reading the article "Eruptions in past have killed many," put the number of people killed by each eruption in the space provided. Use 60 for the approximate number of people killed in the eruption of Mount St. Helens.

Mount Vesuvius	AD 79	_____
Mount Vesuvius	1631	_____
Mount Etna	1669	_____
Mount Skaptar	1783	_____
Tambora	1815	_____
Krakatoa	1883	_____
Mount Pelee	1902	_____
Mount Agung	1963	_____
Mount St. Helens	1980	_____

2. Construct a bar graph, using activity sheet 1, to show the number of deaths.

ACTIVITY SHEET I



NAME: _____ DATE: _____

ACTIVITY II — DISPLACED MATERIAL

1. The amount of material that comes out of a volcano is called "displaced material." Some volcanoes erupt more material than others. Mount St. Helens lost about one square kilometre of material. This material took the form of hot rock and ash which would make a road 10 m wide and 10 cm thick that would go around the world over 32 times.

2. Notice the difference in amounts of material lost by volcanoes shown below.
   a. Which volcano lost the most?

   b. Which volcano lost the least?

3. Make a bar graph of the displaced material on the activity II worksheet.

VOLCANO (DATE)	DISPLACED MATERIAL Volume in cubic kilometres
Mazama (4600 BC)	40
St. Helens (1900 BC)	3.3
Vesuvius (79)	2.7
Hekla (1104)	2.0
Fuji (1500)	1.3
St. Helens (1707)	0.9
Tambora (1815)	80
Krakatoa (1883)	20
Pelee (1902)	0.3
Katmai (1912)	30
St. Helens (1980)	1.0

ACTIVITY SHEET II

Pelee
1902

St. Helens
1707

St Helens
1980

Fuji
1500

Hekia
1104

Vesuvius
79

St. Helens
1900 B.C.

Krakaton
1883

Katmai
1912

Mazama
4600
BC

Tambora
1815

(Volume in cubic kilometers)

80 70 60 50 40 30 20 10 8 6 4 2 0

CUBIC KILOMETERS

99

100

101

NAME: _____ DATE: _____

ACTIVITY III — COMBINATION OF MATERIAL DISPLACED AND HUMAN LOSS

Some of the volcanoes have a record of the number of people killed and amount of displaced material erupted. They are Tambora, Krakatoa, Pelee and the Vesuvius eruption of 79 A.D.

1. In the table below, fill in the number of people killed and amount of displaced material for each volcano.

Volcano	Death toll	Displaced material
Vesuvius	_____	_____
Tambora	_____	_____
Krakatoa	_____	_____
Pelee	_____	_____
St. Helens	_____	_____

2. Make one more bar graph. This time, plot both the people killed and displaced material side by side on activity sheet III. St. Helens is done for you. Use either the shading used in the example or two different colors of crayon or pen.

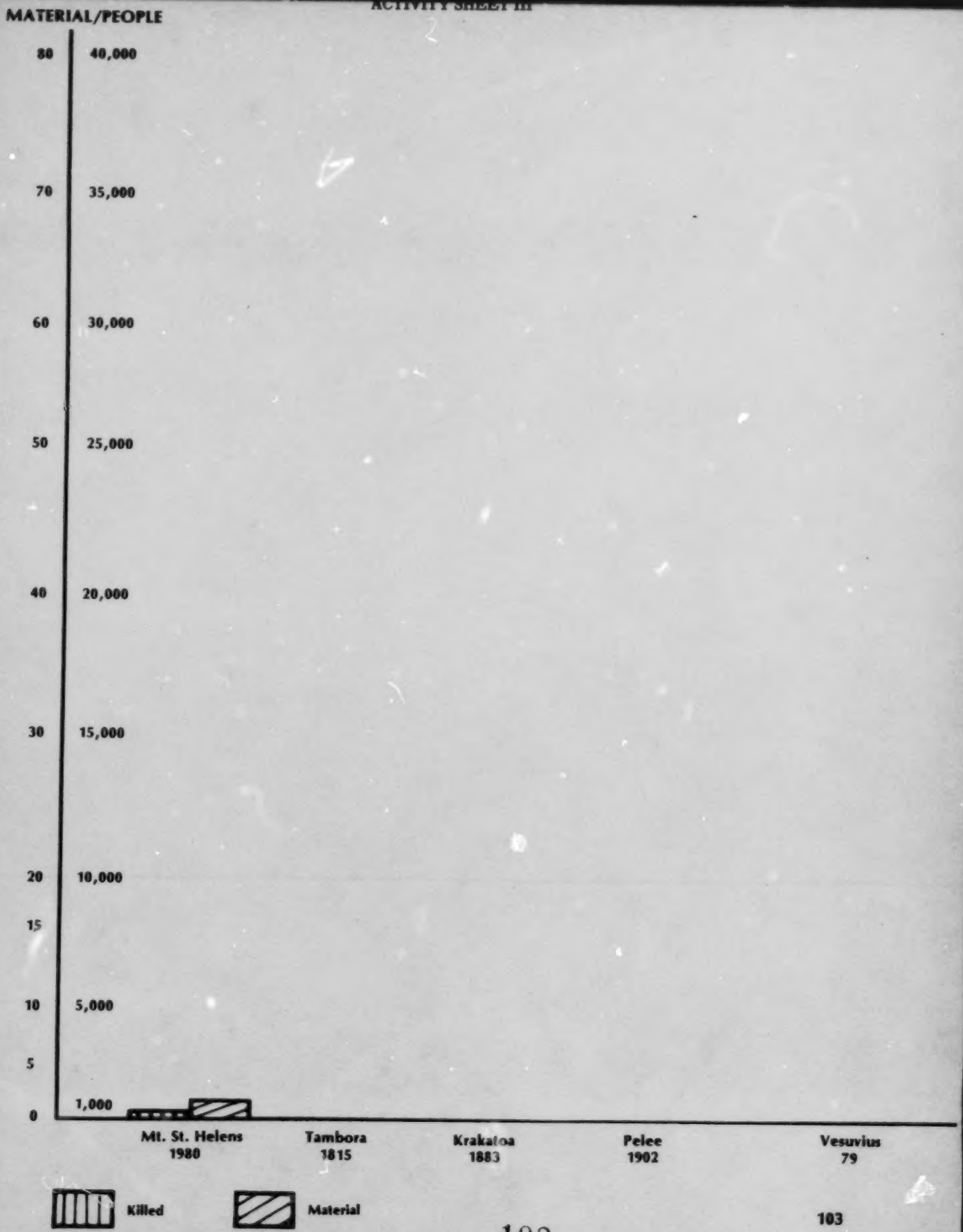
QUESTIONS:

1. As you study the graph on activity sheet III, does it appear that the bigger the eruption, the more people were killed? Which volcanoes make you think so, and why?

2. Tambora and Krakatoa are both islands. Yet Tambora had far fewer deaths. What are some possible explanations?

3. Krakatoa and Pelee killed almost the same number of people, even though Pelee's eruption was not nearly as strong. Why were so many killed by Pelee?

ACTIVITY SHEET III



NAME:_____ DATE:_____

ACTIVITY IV

MATERIALS:
Protractor

PROCEDURE:

1. Using the information in the chart "Volume of Volcano Displacement" activity sheet II, use the protractor to construct a circle graph to determine the location of the pie-shaped sections on the graph. Do not try to make the smaller amounts perfect. (Suggestions: Your measurements should be based on the degrees of circle.)

VOLUME OF VOLCANO DISPLACEMENT
Total Displaced Volume of All Volcanoes+ 180.3 cubic km.

Volcano	Percent of Total	Degrees of Circle
Mazama	22	79 degrees
St. Helens 1900 B.C.	1.7	6 degrees
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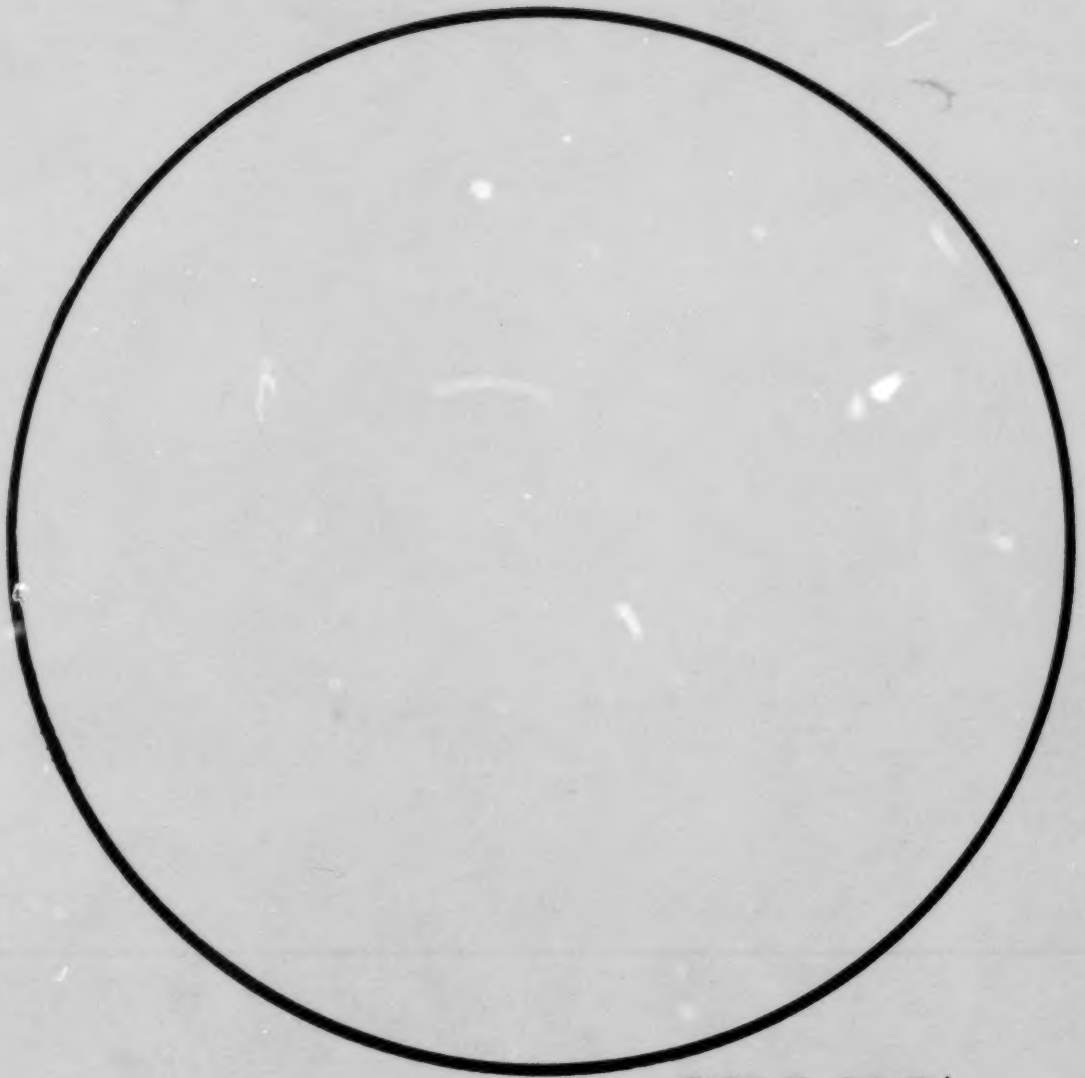
Hekla	1.1	4 degrees
Fuji	.7	2 degrees
St. Helens 1707	.5	2 degrees
Tambora	44	157 degrees
Krakatoa	11 percent	40 degrees
Pelee	.2	1 degree
Katmai	17	61 degrees
St. Helens 1980	.6	2 degrees



CIRCLE GRAPH

NAME: _____ DATE: _____

EXTENDED ACTIVITY — VOLCANIC HIGHWAY

MATERIALS:
Pencil and paper

PROCEDURE:
Answer the questions below. Base your answers on the following information:
1 cubic kilometre was ejected by Mount St. Helens in 1980. (1 cubic kilometre 1,000m X 1,000m X 1,000m)

QUESTIONS:
1. If you used the material ejected in 1980 by Mount St. Helens to construct a road 10m wide by 10cm thick, how long would the road be?

2. How long would the same road be if the material ejected by Mount Tambora was used?

3. Compare this to the distance from Seattle to Washington D.C.

LEVEL INFORMATION: SCI MS

AND THEN, SHE WENT POP!

OBJECTIVES:
The students will:
1. Observe the action of soda and vinegar in a closed container.
2. Hypothesize about the effects of varying the amount of baking soda.

TEACHER BACKGROUND:
1. This should only be done as a demonstration because of the safety factor. Flying corks can and do go astray.
2. The product of soda and vinegar is a gas, carbon dioxide, similar to that found in pop.

TEACHING SUGGESTIONS:
Materials:
Four test tubes
Cork or solid rubber stoppers
Baking soda
Vinegar
Cup (paper)
Plastic spoons (all the same size)
Measuring cup

DEMONSTRATION 1

1. Clean a test tube and cork for this experiment.
2. Place a spoonful of baking soda in the test tube.
3. Add 2 ounces of vinegar to the tube.
4. Quickly, replace the cork lightly over the end of the test tube.
5. Point the tube away from the students.

DEMONSTRATION 2

1. Follow the directions for Demonstration 1, only increase the baking soda to two spoonfuls.

DEMONSTRATION 3

1. Follow the directions for demonstration 1, only decrease the baking soda to ½ spoonful.

DEMONSTRATION 4

1. Follow directions for demonstration 1.
2. Repeat the demonstration, using water in place of vinegar.
3. Compare the amount of material left in the tube after each demonstration.

AND THEN, SHE WENT POP!

REFERENCE ARTICLES:
— "Nature uncorked a very powerful bottle," Page 18
— "Predictions more accurate as time goes on," Page 6

PROCEDURE:
1. Observe the teacher's demonstration.
2. Write possible answers to the questions below; or:
3. Participate in classroom discussion on the questions below.

DEMONSTRATION 1

QUESTIONS:

1. Describe what happened inside the test tube after the vinegar was added.

Answers will vary

2. When the vinegar was added, the cork should have popped out. Why did this happen or not happen?

Because of expanding gases much like those which expanded in Mount St. Helens.

3. Make a prediction about what will happen if the amount of soda is increased from 1 spoonful to 2 spoonfuls.

The cork will probably come out sooner and go farther.

a. Why did you make this prediction?

More soda will produce more gas when mixed with the vinegar.

4. What would happen if you waited one minute to put the cork on the tube? Why?

Nothing, because the reaction is very rapid, and after one minute, it would be over.

DEMONSTRATION 2

1. What happened inside the test tube?

Answers will vary.

2. Were there any differences from demonstration 1? If so list them below.

Answers will vary

3. Make another prediction. What will happen if half as much baking soda is placed in the test tube? (1 spoonful to ½ a spoonful)

The cork will not pop out as far or as quickly.

a. Why did you make this prediction?

Because less gas would be generated the second time, placing less pressure on the liquid in the tube and the cork.

DEMONSTRATION 3

1. What happened inside the tube after the vinegar was added?

Answers will vary

2. What were the differences from the other two demonstrations?

Answers will vary

3. What can you say about the amount of baking soda in vinegar and the cork popping?

The more soda, the more force produced.

4. Read "Nature uncorked a very powerful bottle." How is this demonstration like a volcano?

You may choose to read this article to the class and use this question for discussion.

5. The cork blew out because of an increase in the pressure. What caused this increase in the pop bottle when the soda and vinegar were added?

Gas (CO_2) was produced.

6. a. The same gas in the pop bottle is also produced by Mount St. Helens. The gas is called CO_2 or carbon dioxide. Read the last two columns of "Predictions more accurate as time goes on," Page 6, to find out what this gas does before an eruption.

The amount of gas produced decreases dramatically, 15,000 to 4,000 tons daily.

b. Why does the pressure increase in the volcano, according to this article?

The pressure increases because the volcano becomes "sealed," like the cork sealing the bottle.

DEMONSTRATION 4

1. Which test tubes had the least material after a demonstration?

Soda and vinegar tube

2. Why did the cork pop off the test tube with vinegar, but not the test tube with water?

No gas produced with water

3. Why do you think there was a difference in the amount of material in the vinegar and soda tube?

Part of the soda and vinegar turned into gas

EXTENDED ACTIVITY

1. Name instruments used to measure activity on Mount St. Helens. Make a class chart showing the name of the instrument, what it does and, if possible, a picture or drawing.

NAME: _____ DATE: _____

AND THEN, SHE WENT POP!

REFERENCE ARTICLES:
- "Nature uncorked a very powerful bottle," Page 18
- "Predictions more accurate as time goes on," Page 6

PROCEDURE:
1. Observe the teacher's demonstration.
2. Write possible answers to the questions below; or:
3. Participate in classroom discussion on the questions below.

DEMONSTRATION 1

QUESTIONS:
1. Describe what happened inside the test tube after the vinegar was added.

2. When the vinegar was added, the cork should have popped out. Why did this happen or not happen?

3. Make a prediction about what will happen if the amount of soda is increased from 1 spoonful to 2 spoonfuls.

   a. Why did you make this prediction?

4. What would happen if you waited one minute to put the cork on the tube? Why?

DEMONSTRATION 2

1. What happened inside the test tube?

2. Were there any differences from demonstration 1? If so list them below.

3. Make another prediction.
What will happen if half as much baking soda is placed in the test tube? (1 spoonful to ½ a spoonful)

   a. Why did you make this prediction?

DEMONSTRATION 3

1. What happened inside the tube after the vinegar was added?

2. What were the differences from the other two demonstrations?

3. What can you say about the amount of baking soda in vinegar and the cork popping?

4. Read "Nature uncorked a very powerful bottle." How is this demonstration like a volcano?

5. The cork blew out because of an increase in the pressure. What caused this increase in the pop bottle when the soda and vinegar were added?

6. a. The same gas in the pop bottle is also produced by Mount St. Helens. The gas is called CO_2 or carbon dioxide. Read the last two columns of "Predictions more accurate as time goes on," Page 6, to find out what this gas does before an eruption.

b. Why does the pressure increase in the volcano, according to this article?

DEMONSTRATION 4

1. Which test tubes had the least material after a demonstration?

2. Why did the cork pop off the test tube with vinegar, but not the test tube with water?

3. Why do you think there was a difference in the amount of material in the vinegar and soda tube?

EXTENDED ACTIVITY

Name instruments used to measure activity on Mount St. Helens. Make a class chart showing the name of the instrument, what it does and, if possible, a picture or drawing.

LEVEL INFORMATION: SCI, SS, MATH MS, HS

ASH MASK EFFECTIVENESS

OBJECTIVE:
The students will describe different types of ash masks and analyze their effectiveness.

TEACHING SUGGESTIONS:
1. **Have students read the reference articles.**
2. **Discuss various types of masks and their effectiveness with the class.**
3. **Bring in materials and have students make ash masks.**

ASH MASK EFFECTIVENESS

REFERENCE ARTICLES:
- "Worker safety topic of ash investigation," Page 22.
- "Lung problems up at Moses Lake," Page 24.
- "Dust driving longtime Cougar residents out," Page 21.
- "Health . . .," Page 22
- "Scientists study effects of ash closely," Page 19

ACTIVITY I — ASH MASKS

Read the reference articles and answer the following questions.

1. Why are some fabrics better for making face masks than others?

Because of the coarseness of the material. Fine weaves of material will filter out materials more effectively.

2. Would wearing two masks be better than wearing one? Why?

Yes. The material getting through the first mask may be filtered out by the second. It is very important not to hamper breathing, however.

3. What could you use as a mask if ash started to fall right this minute?

Something you are wearing or have with you

ACTIVITY II — FABRIC VS ASH

1. Bring in various types of material and construct ash masks.
2. Devise ways of testing your masks or fabric samples.

Filtering smoke using a vacuum pump would be an effective way to test the masks. Another might be to wear the mask all day and comparing the discoloration. The easiest method is to pur a mixture of soil and water through, catching the water and testing its clarity.

3. Order the masks for their effectiveness using one of your testing methods.

1. _____

2. _____

3. _____

4. _____

Answers will vary

4. Attach samples of the fabric, No. 1 being the most effective.

No. 1 No. 2 No. 3 No. 4

ACTIVITY III — EMPLOYED AT LAS(H)T!

Pretend you are going to make ash masks for a living. You can buy 10 yards of fabric No. 1 for $10.00. You can buy 10 yards of fabric No. 4 for $5.00. With Fabric No. 1 the cost per mask will be .025; for Fabric No. 4 the cost per mask will be .013.

1. How many masks of Fabric No. 1 would you have to make in a month in order to cover the rent ($400.00), food ($250.00) and gas ($115.00) and electricity ($50.00) if you charged $2.00/mask and you can make 40 masks with 1 yard of fabric?

Total budget required $815.00
Selling price of masks $2.00
Cost of masks at 40 masks per 1 yard at $1.90 a yard .025
2.00 - sale price (profit) 1.98 411/81500 budget
-.025-cost/1.975 - profit
It will take 411 masks to meet the monthly budget.

NAME:_____ DATE:_____

EXTENDED ACTIVITY

1. How long will it take to make 413 masks if each mask takes 15 minutes to complete?

413 X 15 min. = 6,195 min. divided by 60 = 103.25 hours
103.25 hours divided by 4 weeks = 26 hours per week

2. How many masks could you make if you worked 40 hours a week?

40/26 = 65% of full time, leaving 35%
35% of 413 = 144.53 masks
413 masks + 145 masks = 558

3. How much money would you take in if you sold all the masks you made full time?

558 X $2.00 = $1,116.00 - $815.00 budget = $301.00 profit

NAME: _____ DATE: _____

ASH MASK EFFECTIVENESS

REFERENCE ARTICLES:
- "Worker safety topic of ash investigation," Page 22.
- "Lung problems up at Moses Lake," Page 24.
- "Dust driving longtime Cougar residents out," Page 21.
- "Health . . .," Page 22
- "Scientists study effects of ash closely," Page 19

ACTIVITY I — ASH MASKS

Read the reference articles and answer the following questions.

1. Why are some fabrics better for making face masks than others?

2. Would wearing two masks be better than wearing one? Why?

3. What could you use as a mask if ash started to fall right this minute?

NAME: _____ DATE: _____

ACTIVITY II — FABRIC vs. ASH

1. Bring in various types of material and construct ash masks.

2. Devise ways of testing your masks or fabric samples.

3. Order the masks for their effectiveness using one of your testing methods.

1. _____

2. _____

3. _____

4. _____

4. Attach samples of the fabric, No. 1 being the most effective.

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NAME:_____ DATE:_____

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1. How many masks of Fabric No. 1 would you have to make in a month in order to cover the rent ($400.00), food ($250.00) and gas ($115.00) and electricity ($50.00) if you charged $2.00/mask and you can make 40 masks with 1 yard of fabric?

NAME:_____ DATE:_____

EXTENDED ACTIVITY

1. How long will it take to make 413 masks if each mask takes 15 minutes to complete?

2. How many masks could you make if you worked 40 hours a week?

3. How much money would you take in if you sold all the masks you made full time?

LEVEL INFORMATION: LA, SS MS, HS

EMERGENCY

OBJECTIVE:
The students will:
1. Clarify their priorities.
2. Describe steps necessary to evacuate their family on very short notice.
3. Describe what should be ready in emergencies.

TEACHING SUGGESTIONS:
1. The three activities in the unit build on each other. If you do these over an extended time period (several days) be sure to review each activity before proceeding.
2. Tell the students to read the two reference articles in "Mount St. Helens".
3. Conduct a discussion based on the questions in Activity I.
4. Assist the students to complete Activity II.
5. Help the students regroup for Activity III and tell them to follow the directions.

EMERGENCY

REFERENCE ARTICLES:
— "Ominous, eerie hush falls," Page 28
— "Mud turns dream to nightmare," Page 30

PROCEDURE:
1. Read the reference articles.

ACTIVITY I — DECIDE WHAT IS IMPORTANT

1. Imagine that you have just received a report that a mudflow is coming down the river toward your home and you only have 15 minutes to evacuate. You can only take what you can fit into one small suitcase. Describe what you would bring with you, and why.

2. The Althofs found only one possession in the river. Try to think of one possession that would be of comparable personal value that you would want to find in the river.

3. The Althof teakettle is muddy, dented and less than a thing of beauty. Do you think they will throw it away or save it? Why?

ACTIVITY II — PRIORITIES

1. Divide into groups of 6.
2. List your group's highest priorities from Activity I, Question 2.
3. Categorize these priorities (for example, something to wear, paper, etc.)
4. Assign each group member one of the following roles:
   a. (1) Grandmother
      (2) mother/father
      (3) college student
      (4) teen-ager
      (5) third-grader
      (6) kindergartener
   b. As the role player, list what you think should go into the suitcase.
   c. Carry out a conversation you might have had when the word came that the family would be evacuated in 15 minutes. Try to come to a consensus on what should go into a suitcase.
   d. List below the suitcase contents.
   e. Did everyone in the family include a personal momento or were family momentoes included, or both? Why?
5. List any similarities between decisions you made in the role play and the priorities you listed in Question 2.

ACTIVITY III — GET TOGETHER

Form new groups, composed of students playing the same role in the play (i.e. all grandmothers in one group, all mothers/fathers in one group, etc.)

1. List the similarities you find in the role plays of things chosen for the suitcase from activity II, 4c.
2. Categorize these similarities. Make a list of the categories.

EXTENDED ACTIVITY — MUDFLOW:

1. Imagine you are an archeologist from the 25th century excavating the St. Helens mudflow. As you dig down through the layers of dirt, mud, silt and rock, you find the following items: a leather boot; a digital watch; a Volkswagen Beetle; a pocket calculator; an aluminum pop can; a rubber raft; and a steel-belted radial tire. Write a report explaining what conclusions you would draw about life in Washington at the time of the Mount St. Helens eruption.

2. Try to associate the pioneers who left their possessions behind to cross the Rocky Mountains to the people that left their home because of Mount St. Helens. What did they have in common and what were the differences?

Possible answer: Common — both could not take many items with them. Differences — Pioneers were looking for a new home; the Mount St. Helens refugees were leaving their home.

NAME: _____ DATE: _____

EMERGENCY

REFERENCE ARTICLES:
— "Ominous, eerie hush falls," Page 28
— "Mud turns dream to nightmare," Page 30

PROCEDURE:
1. Read the reference articles.

ACTIVITY 1 — DECIDE WHAT IS IMPORTANT

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2. The Althofs found only one possession in the river. Try to think of one possession that would be of comparable personal value that you would want to find in the river.

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NAME: _____ DATE: _____

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      (5) third-grader
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   b. As the role player, list what you think should go into the suitcase.

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   d. List below the suitcase contents.

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NAME: _____ DATE: _____

ACTIVITY III — GET TOGETHER

Form new groups, composed of students playing the same role in the play (i.e. all grandmothers in one group, all mothers/fathers in one group, etc.)

1. **List the similarities you find in the role plays of things chosen for the suitcase from activity II, 4c.**

2. **Categorize these similarities. Make a list of the categories.**

NAME:_____ DATE:_____

EXTENDED ACTIVITY — MUDFLOW:

1. Imagine that you are an archeologist in the 25th century excavating the Mount St. Helens mudflow. As you dig down through the layers of dirt, mud, silt and rock, you find the following items: a leather boot; a digital watch; a Volkswagen Beetle; a pocket calculator; an aluminum pop can; a rubber raft; and a steel-belted radial tire. Write a report explaining what conclusions you would draw about life in Washington at the time of the Mount St. Helens eruption.

2. Try to associate the pioneers who left their possessions behind to cross the Rocky Mountains to the people that left their home because of Mount St. Helens. What did they have in common and what were the differences?

LEVEL INFORMATION: SS, SCI MS

ASH AFFECTS PEOPLE

OBJECTIVES:
The students will:
1. Describe several ways in which ash affects people's lives.
2. Identify cities most heavily affected by ash.

TEACHING SUGGESTIONS:
1. Read the reference articles.
2. Discuss the ash fall situation with students.
3. Brainstorm effects of ash fall with students.
4. Here are some alternate ideas for role play situations.
1. A mother or father explaining the need to wear an ash mask to an uncooperative youngster.
a. Family discussion about ash clean up around the house. No one wants to tackle the sidewalk, but everyone needs to go out.
b.. A frazzled teacher deals with students that have not been out for recess for two weeks. Finally, a window gets broken.

ASH AFFECTS PEOPLE

REFERENCE ARTICLES:
— "Lung problems up at Moses Lake," Page 24
— "Gritty stuff brings early summer vacation," Page 24
— "Dust driving longtime Cougar residents out, Page 21
— "Conflicting views erupt on ash effect," Page 23
— "Worker safety topic of ash investigation," page 22
— Photomicrograph," page 23
— "Violence up in ash-clogged areas," Page 23
— "Ash loss to farmers put at $175 million," Page 25
— Map, Page 26

PROCEDURE:
After reading the reference articles, answer the following questions:
1. How could ash damage homes?

Ash is so fine it gets into homes through the smallest openings. It scratches almost everything it rubs against. It will cut fabrics if not cleaned up soon.

2. How does ash affect the air we breathe?
How can people modify the air before breathing it?

Ash in the air is choking to breathe. Special face masks should be worn when enough is there to make it visible.

3. Why do you think WSU and UW have conflicting opinions about the dangers of inhaling ash?

There is not enough evidence to support or disaprove either opinion.

4. How does ash affect water supply and waste treatment plants?

Ash clogs filters in water treatment plants. It can damage pumps and fills waste treatment plants with material that does not break down.

5. How does ash affect transportation?

Ash is very abrasive on all machinery with moving parts. It plugs air filters, gets into fuel systems, and has ruined a jet engine is less than five minutes. The dust on roads is slippery and reduces visibility to as little as 3 feet.

6. How much ash fell on different cities in Washington state after the May eruption? (List six cities and the amount of ash).

Yakima, 10mm; Moses Lake, 50mm; Ritzville, 60mm; Ellensburg, 10mm; Ephrata, 30mm; Pasco, 2mm; Wenatchee, 2mm; and Spokane, 20mm.

a. What are some of the ways in which cities were affected by ash?

Cities in line with the ash cloud were disrupted according to the amount of ash received.

7. What was the effect of ash on farm crops?

Many farm crops were covered. Fruit trees had ash blown off with helicopters, hay crops could not be used if too much ash was present as animals would not eat them. Vegetable gardens had small plants covered by ash. Ash sometimes caked on the soil so water could not easily penetrate.

8. What was the effect of ash on animals?

Some animals had their lungs affected by the dust. Cows will have their teeth worn down by ash-covered grass and hay. Most animals in the devastated area were destroyed. Birds left their nests. The insect population was destroyed in many places and there was no food. Fish in ash-filled streams died due to the high temperatures, the abrasive action of the ash on their gills and suffocation due to the lack of oxygen. If the fish survived the ash and temperatures, they found their food supply had been destroyed.

9. What are some things that must be done to make the rivers liveable for the fish again?

Need lower temperature, less suspended materials and a food source.

10. Would you recommend that the area around the mountain and Spirit Lake be reforested? Why?

Answers vary. Should be reforested to restore beauty, lessen fire hazard. Should not be reforested to preserve the blast's destruction for other to see.

11. The term "prisoner in your own home" might apply to the ash situation. What does this term mean in relation to the ash, and how do you think people would change if bombarded with ash fallout for a prolonged period of time?

Answers will vary. Many people could not escape the ash effected area and if they had breathing problems they were stranded at home. If this continued people could become depressed, violent, fearful, apathetic about themselves and those around them.

12. In the article, "Violent Acts Erupt in Ash Clogged Areas of State," there appears to be some link between what people do and the ash fall. Why do you think this is or is not so?

Answers vary

ACTIVITY II — TRAPPED!

1. Role play a family of four (mother, father, teen-ager, youngster) trapped in their home by ash. In the role play, keep in mind the gray outdoors; the masks nearby; the lung congestion; and the isolation. The family has just run out of milk and eggs.

ACTIVITY III — WARNING — ASH FALL!

If you knew that an ash fall was heading your way in two hours, what sort of things do you think a family should do before it becomes dangerous outside? Use your own family as an example. Consider food needed, protective wear, the pets, the garden, the home. List below what you feel each family member's responsibilities would be.

Mother

Father

You

Brother

Sister

NAME: _____ DATE: _____

ASH AFFECTS PEOPLE

REFERENCE ARTICLES:
- "Lung problems up at Moses Lake," Page 24
- "Gritty stuff brings early summer vacation," Page 24
- "Dust driving longtime Cougar residents out, Page 21
- "Conflicting views erupt on ash effect," Page 23
- "Worker safety topic of ash investigation," page 22
- Photomicrograph, page 23
- "Violence up in ash-clogged areas," Page 23
- "Ash loss to farmers put at $175 million," Page 25
- Map, Page 26

PROCEDURE:
After reading the reference articles, answer the following questions:

1. How could ash damage homes?

2. How does ash affect the air we breathe?

How can people modify the air before breathing it?

3. Why do you think WSU and UW have conflicting opinions about the dangers of inhaling ash?

4. How does ash affect water supply and waste treatment plants?

5. How does ash affect transportation?

6. How much ash fell on different cities in Washington state after the May eruption? (List six cities and the amount of ash).

a. What are some of the ways in which cities were affected by ash?

7. What was the effect of ash on farm crops?

8. What was the effect of ash on animals?

9. What are some things that must be done to make the rivers liveable for the fish again?

10. Would you recommend that the area around the mountain and Spirit Lake be reforested? Why?

11. The term "prisoner in your own home" might apply to the ash situation. What does this term mean in relation to the ash, and how do you think people would change if bombarded with ash fallout for a prolonged period of time?

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NAME: _____ DATE: _____

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NAME: _____ DATE: _____

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Mother

Father

You

Brother

Sister

LEVEL INFORMATION: SCI, MATH MS, HS

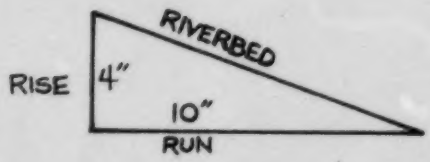
MUDFLOW SIMULATION

OBJECTIVES:
The students will:
1. Observe a simulated mudflow and record time and rate of flow.
2. Describe the effect of slope and debris on the rate of mudflow.
3. Compare the destructive force of mudflow with and without debris.

TEACHING BACKGROUND:
"Mudflows (sometimes called lahars) have killed more people and destroyed more property than any other type of volcanic activity in the past few centuries."*
Much of the material needed for these activities may be used or recycled items. Students may be able to donate some of these items and also set up the models. The time and rate data for mudflows will vary with soil type used to make mud, amount of debris used, etc. This should not be a problem, since no two mudflows are identical.

*From Volcanoes, Her Majesty's Stationery Office
copyright (c) Crown, 1974

TEACHING SUGGESTIONS:
1. After the students have read the reference articles, they should write the facts concerning the rate of mudflow.
2. One of the riverbed models should be selected for construction. (See Page 32). The plaster of Paris riverbed may be suited to large group instruction, while the other two models, which are simpler, can be prepared in pairs or small groups.
3. Calculating the slope of the riverbed should be discussed and practiced, using the constructed riverbeds or simpler models.



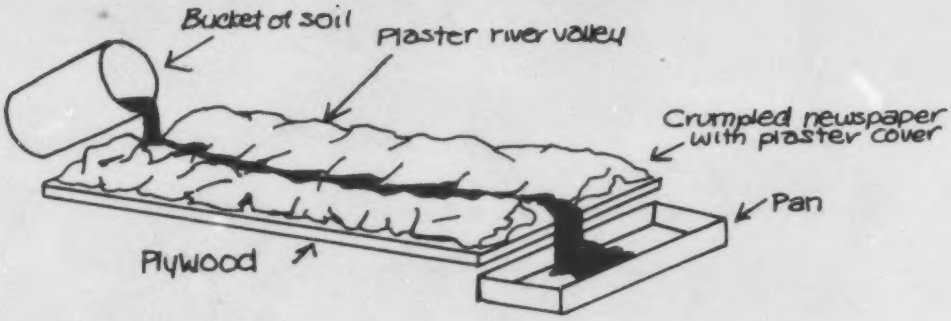
4. The experiments should be done in pairs or threes.

MUDFLOW SIMULATION

REFERENCE ARTICLES:
— "Columbia dredging ahead of schedule," Page 32
— "Columbia may be blocked for months," Page 32
— "Will Never Forget," Page 27
— "Toutle: She's Gone Forever," Page 28
— "Mud Destroys House, Dream," Page 30

MATERIALS:
Large pan
Buckets
Stop watch
Yard Stick
Twigs, small sticks, toy cars, bridges
Mud

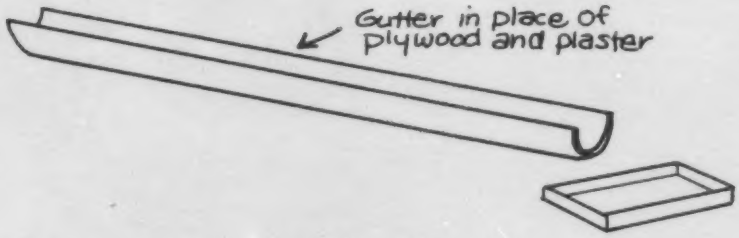
PLASTER OF PARIS MODEL:



TEACHING SUGGESTIONS:
This model is the most realistic, but also requires the most time. Ambitious students could include roadways and bridges.

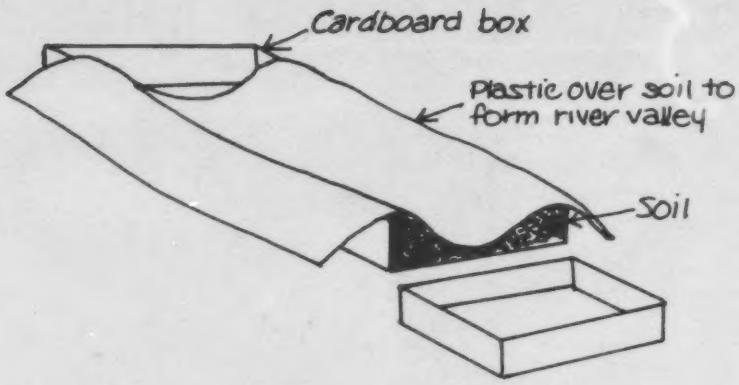
1. Obtain a 3-by-6-foot sheet of plywood.
2. Mold shape of river valley from crumpled newspaper.
3. Pour plaster of Paris over newspaper, mold to desired shape and let dry.
4. Seal dried plaster with varnish, paint or other sealant.
5. Incline the box, using books for support, or use a suspension system from ring stand or ceiling.

GUTTER MODEL:



1. Cut a section of drain pipe or rain gutter, about 4 feet long.
2. Incline the gutter, using books for support, or use a suspension system from a ring stand or ceiling.

CARDBOARD MODEL:



1. Put soil or papers into a shallow cardboard box to contour the "river walls."
2. Place a sturdy plastic garbage sack into the bed and contour over the soil.
3. Cut the bottom edge of the cardboard to allow the mud to flow out.
4. Incline the riverbed using books or suspension system from the ceiling.

ACTIVITY I — DOES THICKNESS COUNT?

1. A. Set up model riverbed as shown.
   B. Calculate the slope of your riverbed. Slope Rise divided by Run.
2. Make mud of three consistencies from thin to thick.
3. Divide each consistency into two equal portions in separate buckets. Mix debris (broken twigs and sticks) into one portion from each consistency.
4. Pour each mud mixture into the river valley as indicated in the set up.
5. Observe and calculate the following:
   a. Rate of flow for each mud mixture without debris. Record in the table the time it takes mud to reach the end of your river valley. Calculate and record the rate in cm/sec.
   b. Repeat Part A using mud mixtures with debris.
6. Repeat Part 5 with the river valley at two other slopes.

TIME TABLE

Mud mix / Slope	Without debris			With debris		
	1	2	3	1	2	3

RATE TABLE

Mud mix / Slope	Without debris			With debris		
	1	2	3	1	2	3

QUESTIONS/CONCLUSIONS:

1. How does slope affect rate of mud flow?

Speeds up.

2. How does debris affect rate of mud flow?

Slows down.

3. Which type of mudflow, with or without debris, do you think may be the most dangerous?

With debris — the debris causes damming of the flow which results in increased pressure and therefore the possibility of more damage.

ACTIVITY II — WHAT HAPPENS TO OBJECTS IN THE PATH OF A MUDFLOW?

Destructive force:

Set up is the same as for debris and mudflow activity.

1. Place objects of various size, shape and weight in the river valley.
2. Pour in various mud mixtures and record observations in chart below.

Mud mix / object	Without debris			With debris		
	1	2	3	1	2	3
Object 1						
Shape						
Weight						
Object 2						
Shape						
Weight						
Object 3						
Shape						
Weight						

QUESTIONS:

1. Which objects are moved most easily?

Lightweight, chunky objects, for example, toy cars, rather than elongated pencils or heavy objects.

2. Are there any which remain stationary?

Yes/No

3. What do you think debris does to the destructive force of a mudflow?

Increases it.

NAME: _____ DATE: _____

MUDFLOW SIMULATION

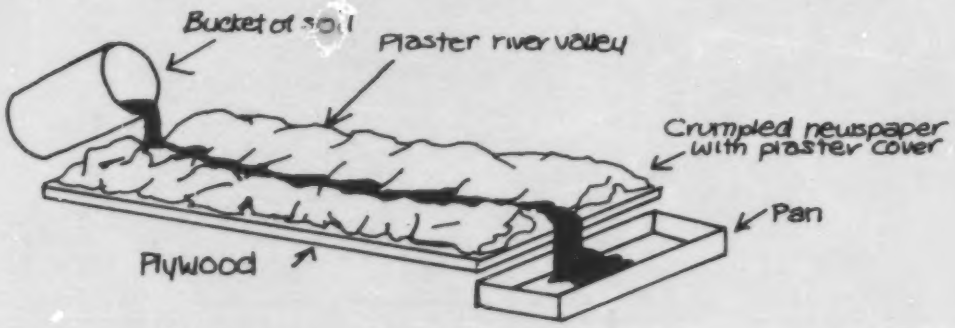
REFERENCE ARTICLES:

— "Columbia dredging ahead of schedule," Page 32
— "Columbia may be blocked for months," Page 32
— "Will Never Forget," Page 27
— "Toutle: She's Gone Forever," Page 28
— "Mud Destroys House, Dream," Page 30

MATERIALS:

Large pan
Buckets
Stop watch
Yardstick
Twigs, small sticks, toy cars, bridges
Mud

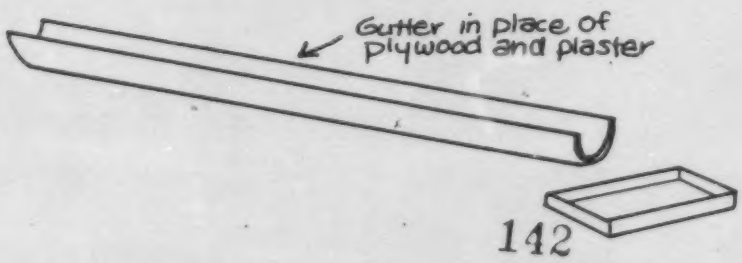
PLASTER OF PARIS MODEL:



1. Obtain a 3-by-6-foot sheet of plywood..
2. Mold shape of river valley from crumpled newspaper.
3. Pour plaster of Paris over newspaper, mold to desired shape and let dry.
4. Seal dried plaster with varnish, paint or other sealant.
5. Incline the box, using books for support, or use a suspension system from ring stand or ceiling.

GUTTER MODEL:

1. Cut a section of drain pipe or rain gutter, about 4 feet long.
2. Incline the gutter, using books for support, or use a suspension system from a ring stand or ceiling.



CARDBOARD MODEL:

1. Put soil or papers into a shallow cardboard box to contour the "river walls."
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3. Cut the bottom edge of the cardboard to allow the mud to flow out.
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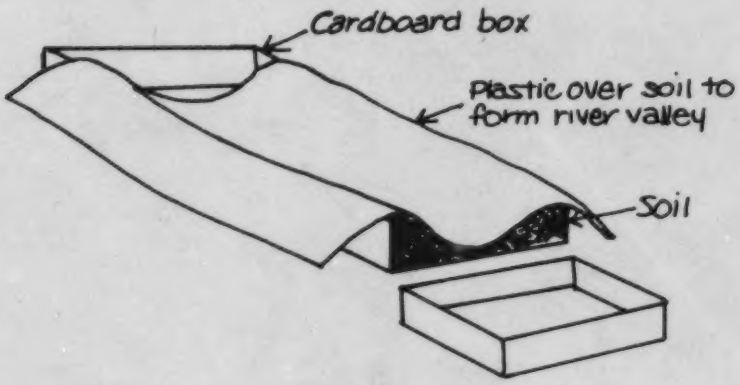


NAME: _____ DATE: _____

ACTIVITY I — DOES THICKNESS COUNT?

1. A. Set up model riverbed as shown.
   B. Calculate the slope of your riverbed. Slope Rise divided by Run.
2. Make mud of three consistencies from thin to thick.
3. Divide each consistency into two equal portions in separate buckets. Mix debris (broken twigs and sticks) into one portion from each consistency.
4. Pour each mud mixture into the river valley as indicated in the set up.
5. Observe and calculate the following:
   a. Rate of flow for each mud mixture without debris. Record in the table the time it takes mud to reach the end of your river valley. Calculate and record the rate in cm/sec.
   b. Repeat Part A using mud mixtures with debris.
6. Repeat Part 5 with the river valley at two other slopes.

TIME TABLE

Slope \ Mud mix	Without debris			With debris		
	1	2	3	1	2	3

RATE TABLE

Slope \ Mud mix	Without debris			With debris		
	1	2	3	1	2	3

QUESTIONS/CONCLUSIONS:

1. How does slope affect rate of mud flow?

2. How does debris affect rate of mud flow?

3. Which type of mudflow, with or without debris, do you think may be the the most dangerous?

NAME: _____ DATE: _____

ACTIVITY II — WHAT HAPPENS TO OBJECTS IN THE PATH OF A MUDFLOW?

Destructive force:

Set up is the same as for debris and mudflow activity.

1. Place objects of various size, shape and weight in the river valley.
2. Pour in various mud mixtures and record observations in chart below.

Mud mix / object	Without debris			With debris		
	1	2	3	1	2	3
Object 1						
Shape						
Weight						
Object 2						
Shape						
Weight						
Object 3						
Shape						
Weight						

QUESTIONS:

1. Which objects are moved most easily?

2. Are there any which remain stationary?

3. What do you think debris does to the destructive force of a mudflow?

LEVEL INFORMATION: SCI MS, HS

TOTAL SUSPENDED SOLIDS IN TOUTLE RIVER

OBJECTIVE:

The student will compare samples of suspended solids in water with available date and relate them to fish survival.

TEACHER BACKGROUND:

The Toutle and Cowlitz rivers are still carrying a great quantity of sediment and suspended solids resulting from the mudflow caused by the eruption of Mount St. Helens on May 18, 1980.

Two kinds of technical measurements are taken monthly by the Washington state Department of Ecology. One, a measurement of turbidity, or how clear the water is, is reported in Jackson Turbidity Units (JTU), a national standard. The second is a measure of the weight of solids suspended in the water, and is reported as Total Suspended Solids (TSS) in milligrams per litre.

TOTAL SUSPENDED SOLIDS IN TOUTLE RIVER

REFERENCE ARTICLES:

— "Nature Helping To Clean Toutle River," Page 29
— Picture, junction of Toutle and Cowlitz rivers, Page 29
— "Salmon Survival Doubtful," Page 47
— "Warm Toutle and Cowlitz Killing Fish," Page 46
— "Photomicrograph of ash," Page 23
— "Toutle: She's Gone Forever," Page 28

MATERIALS:

Three clear litre containers with lids (quart mayonnaise jars are very close to a litre)
Ash (or soil or fine sand)
Talcum powder
Centigrade thermometer

ACTIVITY I — EFFECT OF AMOUNT, TYPE OF MATERIAL, TEMPERATURE ON SETTLING RATE

PROCEDURE:

Part A.

1. Fill each container with about one litre of water.
2. Put .03 grams of ash or sand in container 1.

> If this measurement is difficult, put nothing in this container and explain the situation to the students.

Put 5g in container 2
Put 10g in container 3

3. Shake the container vigorously.
4. Make three observations of the clarity and rate of settling for each container — at 1 minute, at 2 minutes and at 4 minutes. Record your observations on Data Table I. Use the key provided.

DATA TABLE I

	.03g		5g		10g	
Min.	Clarity	Settling rate	Clarity rate	Setting rate	Clarity	Setting
1	1	C	2	B	3	A
2	1	C	2	B	2	A
4	1	C	1	A	2	A

Key

Clarity	Settling rate
1. Mostly clear	A. A great deal
2. Fairly clear	B. Some
3. Cloudy	C. Very little

Key is subject to type of suspended material

In parts A and B, be certain that the material is uniform in all three containers. If metric measurement is not satisfactory, use a similar measurement in tablespoons or ounces.

Part B.

1. Fill container A with water and heat to 50 degrees Celsius.
   Fill container B with water at 25 degrees Celsius.
   Fill container C with water at 15 degrees Celsius.
2. Put 10g material in each and agitate.
3. Make three observations of the clarity and rate of settling for each container — at 1 minute, at 2 minutes and at 4 minutes. Record your observations on the clarity and speed of settling on Data Table II. Use the keys provided.

DATA TABLE II

	15C		25C		50C	
Min.	Clarity	Settling rate	Clarity rate	Setting rate	Clarity	Setting
1	3	C	3	C	3	B
2	3	C	3	B	3	B
4	2	B	3	B	3	B

Key

Clarity	Settling rate
1. Mostly clear	A. A great deal
2. Fairly clear	B. Some
3. Cloudy	C. Very little

Part c:

1. Fill containers A, B and C with cold water.
2. Put 10g of sand into container A.
   Put 10g of talcum powder into container B.
   Put 5g each of sand and talcum powder into container C.
3. As with parts A and B, make three observations and record your observations on Data Table III.

DATA TABLE III

	10g sand		13g talcum		5g sand, 5g talcum	
Min.	Clarity	Settling rate	Clarity rate	Setting rate	Clarity	Setting
1	1	A	3	C	2	B
2	1	A	3	C	2	B
4	1	A	3	C	2	B

Key

Clarity	Settling rate
1. Mostly clear	A. A great deal
2. Fairly clear	B. Some
3. Cloudy	C. Very little

Notice how long it takes for the mixture of 5g of talcum powder and 5g of sand to settle. This approximates the amount of suspended material in the Toutle River on May 21, 1980. How would the settling time in your activity would compare to that for the Toutle River. Why?

It will take a great deal longer for material in the river to settle because the motion of the river will keep the contents in suspension.

STUDY QUESTIONS:

1. Which variable most affects the clarity of water; amount of material, temperature or type of material?

Amount.

2. Which variable most affects the rate of particulate settling; amount of material, temperature or type of material?

Type of material.

3. What do you think would be the effect on the river if a major eruption put large quantities of hot ash in it?

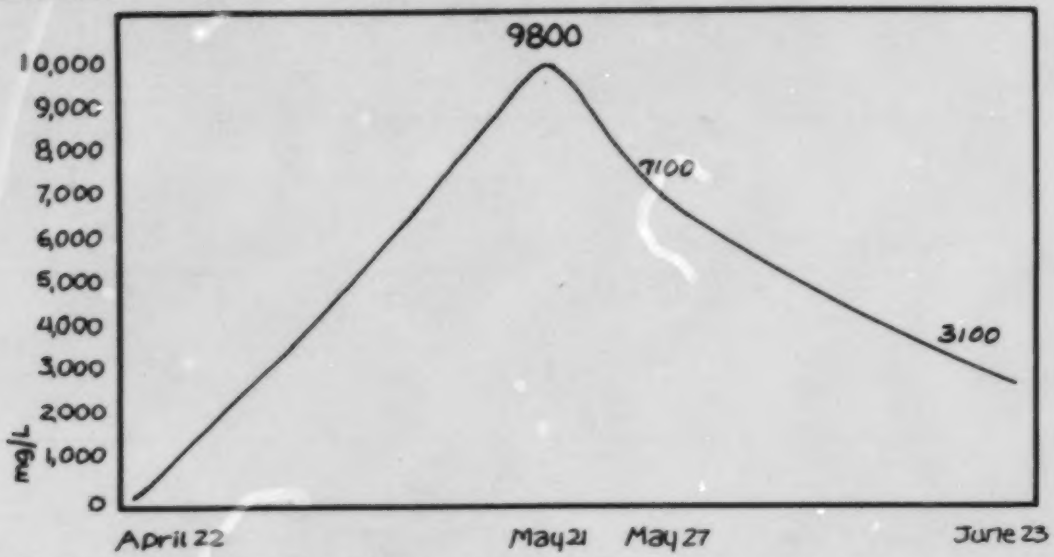
Some possible answers would deal with shallowing due to sediment, effect of ash on fish, effect of heat on fish, a mudflow effect on bridges and roads, etc.

4. Read the two reference articles about fish and see the photograph of the ash as it appears when magnified. What happens when river fish are subjected to a dramatic increase in suspended materials? Why?

The available oxygen in the water, which is needed by the fish, is depleted. The gill structure which traps the oxygen also becomes clogged, and the abrasive action of the material upon the gill structure may cause the fish to bleed to death.

ACTIVITY II — CLEARING RATE

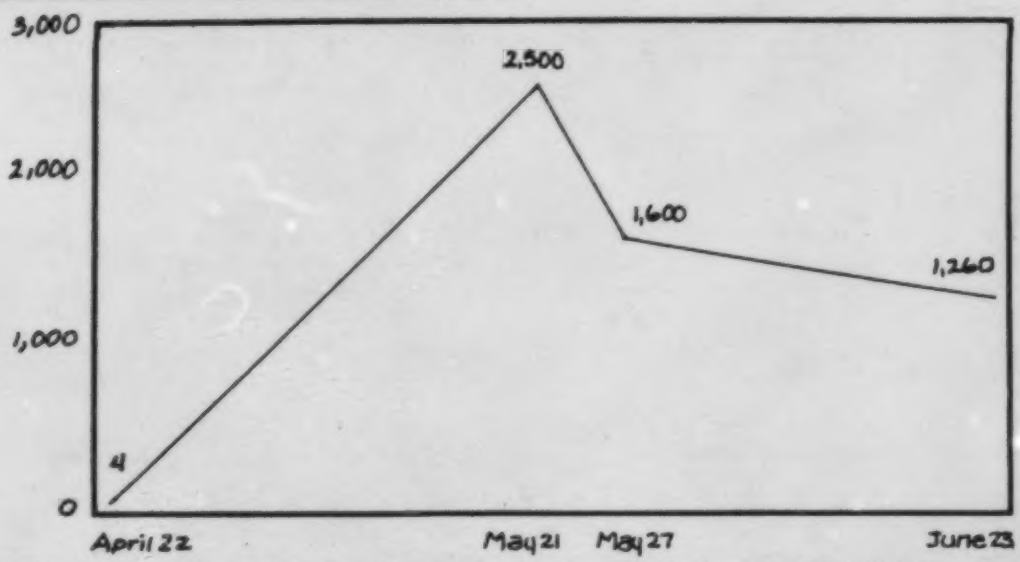
PROCEDURE:



1. Use the data from Appendix II to plot the point for the TSS (Total Suspended Solids) on graph A, starting with May 21.
2. Find the optimum clearing rate. Express your answers in mg/1/day.*

*/1/day is read as milligrams per litre per day

May 21-27 — 6 days	May 27-June 23 — 27 days
9,800	7,100
7,100	3,100
2,700	4,000
2,700mg/6 days = 450mg/1 day	4,000mg/27 days = 48mg/1 day



1. Use the data from Appendix II to plot the point for the JTU (Jackson Turbidity Units) on Graph B, starting with May 21.
2. Find the clearing rate in JTU/day.

May 21-27 — 6 days	May 27-June 23 27 days
2500	1600
1600	260
900	340
900/6 = 150 JTU/day	1,340/27 = 50 JTU/day

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STUDY QUESTIONS:

1. What does turbidity mean?

The amount of material in the water that affects the clarity of the water.

2. Do turbidity and total suspended solids seem to be related?

They have very similar patterns and settling rates.

EXTENDED ACTIVITIES:

1. Develop a method to measure clarity or turbidity of the water.
2. Use data from your State Department of Ecology or other agency responsible for monitoring local water quality. Compare to statistics for Toutle River.
3. Use the information in Tables 1 and 2 to provide evidence to confirm your conclusion.

NAME: _____ DATE: _____

TOTAL SUSPENDED SOLIDS IN TOUTLE RIVER

REFERENCE ARTICLES:
- "Nature Helping To Clean Toutle River," Page 29
- Picture, junction of Toutle and Cowlitz rivers, Page 29
- "Salmon Survival Doubtful," Page 47
- "Warm Toutle and Cowlitz Killing Fish," Page 46
- "Photomicrograph of ash," Page 23
- "Toutle: She's Gone Forever," Page 28

MATERIALS:
Three clear litre containers with lids (quart mayonnaise jars are very close to a litre)
Ash (or soil or fine sand)
Talcum powder
Centigrade thermometer

ACTIVITY I — EFFECT OF AMOUNT, TYPE OF MATERIAL, TEMPERATURE ON SETTLING RATE

PROCEDURE:
Part A.

1. Fill each container with about one litre of water.
2. Put .03 grams of ash or sand in container 1.
   Put 5g in container 2
   Put 10g in container 3
3. Shake the container vigorously.
4. Make three observations of the clarity and rate of settling for each container — at 1 minute, at 2 minutes and at 4 minutes. Record your observations on Data Table I. Use the key provided.

DATA TABLE I

	03g		5g		10g	
Min.	Clarity	Settling rate	Clarity rate	Setting rate	Clarity	Setting
1						
2						
4						

Key

Clarity	Settling rate
1. Mostly clear	A. A great deal
2. Fairly clear	B. Some
3. Cloudy	C. Very little

Part B.

1. Fill container A with water and heat to 50 degrees Celsius.
   Fill container B with water at 25 degrees Celsius.
   Fill container C with water at 15 degrees Celsius.
2. Put 10g material in each and agitate.
3. Make three observations of the clarity and rate of settling for each container — at 1 minute, at 2 minutes and at 4 minutes. Record your observations on the clarity and speed of settling on Data Table II. Use the keys provided.

DATA TABLE II

	15C		25C		50C	
Min.	Clarity	Settling rate	Clarity rate	Setting	Clarity	Setting rate
1						
2						
4						

Key

Clarity	Settling rate
1. Mostly clear	A. A great deal
2. Fairly clear	B. Some
3. Cloudy	C. Very little

Part c:

1. Fill containers A, B and C with cold water.
2. Put 10g of sand into container A.
   Put 10g of talcum powder into container B.
   Put 5g each of sand and talcum powder into container C.
3. As with parts A and B, make three observations and record your observations on Data Table III.

DATA TABLE III

	10g sand		13g talcum		5g sand, 5g talcum	
Min.	Clarity	Settling rate rate	Clarity rate	Setting	Clarity	Setting
1						
2						
4						

Key

Clarity	Settling rate
1. Mostly clear	A. A great deal
2. Fairly clear	B. Some
3. Cloudy	C. Very little

Notice how long it takes for the mixture of 5g of talcum powder and 5g of sand to settle. This approximates the amount of suspended material in the Toutle River on May 21, 1980. How would the settling time in your activity would compare to that for the Toutle River. Why?

STUDY QUESTIONS:

1. Which variable most affects the clarity of water; amount of material, temperature or type of material?

2. Which variable most affects the rate of particulate settling; amount of material, temperature or type of material?

3. What do you think would be the effect on the river if a major eruption put large quantities of hot ash in it?

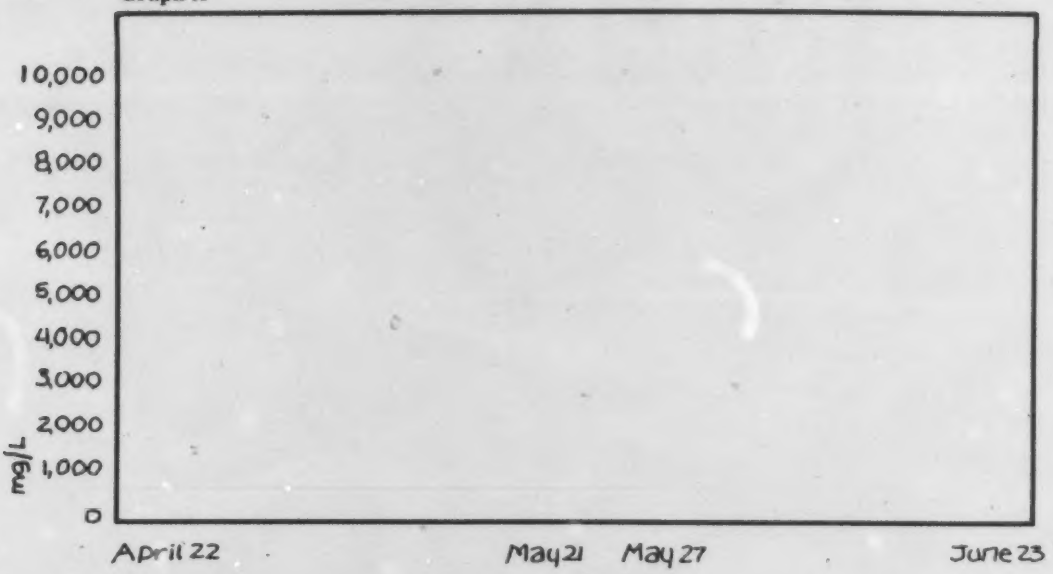
4. Read the two reference articles about fish and see the photograph of the ash as it appears when magnified. What happens when river fish are subjected to a dramatic increase in suspended materials? Why?

NAME:_____ DATE:_____

ACTIVITY II — CLEARING RATE

PROCEDURE:

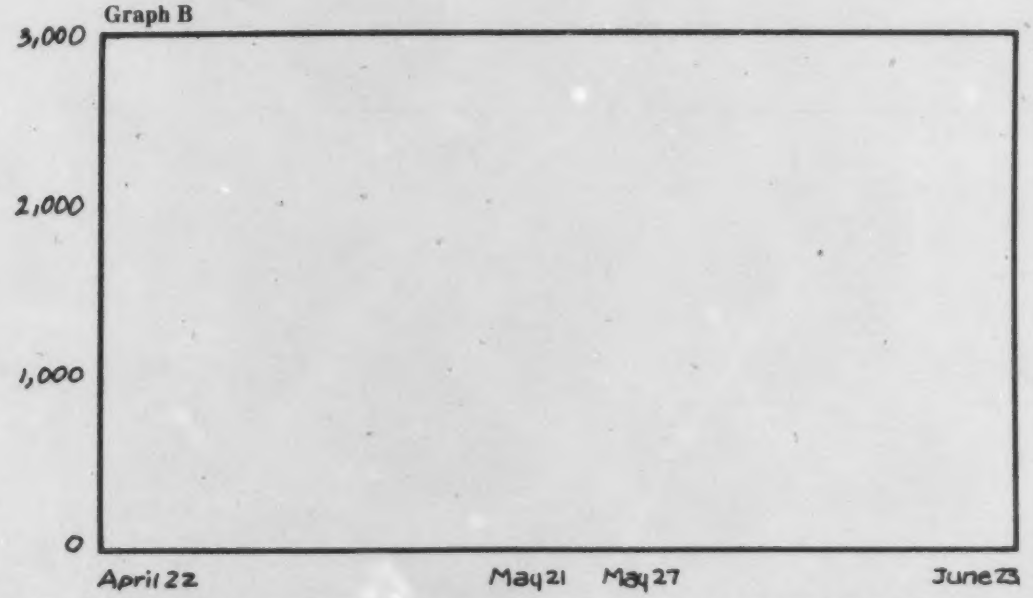
Graph A



1. Use the data from Appendix II to plot the point for the TSS (Total Suspended Solids) on graph A, starting with May 21.
2. Find the optimum clearing rate. Express your answers in mg/1/day.*

*/1/day is read as milligrams per litre per day

Graph B



1. Use the data from Appendix II to plot the point for the JTU (Jackson Turbidity Units) on Graph B, starting with May 21.
2. Find the clearing rate in JTU/day.

STUDY QUESTIONS:

1. What does turbidity mean?

2. Do turbidity and total suspended solids seem to be related?

NAME: _____ DATE: _____

EXTENDED ACTIVITIES:

1. Develop a method to measure clarity or turbidity of the water.
2. Use data from your State Department of Ecology or other agency responsible for monitoring local water quality. Compare to statistics for Toutle River.
3. Use the information in Tables 1 and 2 to provide evidence to confirm your conclusion.

LEVEL INFORMATION: SS MS, HS

PEOPLE, SHIPS, LOGS AND TRAVEL vs. MUDFLOW

OBJECTIVE:
The students will describe in their own words the effects of mudflows on people and their property, transportation and the logging industry.

PEOPLE, SHIPS, LOGS AND TRAVEL vs. MUDFLOW

REFERENCE ARTICLES:
- Photo, Page 31
- "Couple struggle for life," Page 40
- "Ominous, eerie hush," Page 28
- Photo, Cowlitz and Toutle rivers meet, Page 29
- "Tragedy's toll . . ." Page 30
- "Mud from volcano clogs Columbia River," Page 32
- "Volcano's effects less than feared," Page 32

PROCEDURES:
Read the reference articles.

QUESTIONS:

1. What did the mudflows do to trucks and machines?

The mudflows buried the trucks and machines or badly damaged them.

2. What did the mudflows do to the log piles?

The log piles were scattered and floated away.

3. How did the mudflows affect people's travel in the valley?

People can no longer travel over roads that were flooded or over washed-out bridges.

4. Why is a low area next to the river a poor place to build?

Low areas are frequently flooded even in normal times. Mudflows demolished many buildings.

5. How did mudflows affect ship traffic in the Columbia River?

Ship traffic was completely halted for a period of time because large ocean ships often draw up to 35 feet and mud filled the Columbia ship channel from its normal 40 foot depth to only 15 feet.

NAME: _____ DATE: _____

PEOPLE, SHIPS, LOGS AND TRAVEL vs. MUDFLOW

REFERENCE ARTICLES:

— Photo, Page 31
— "Couple struggle for life," Page 40
— "Ominous, eerie hush," Page 28
— Photo, Cowlitz and Toutle rivers meet, Page 29
— "Tragedy's toll . . ." Page 30
— "Mud from volcano clogs Columbia River," Page 32
— "Volcano's effects less than feared," Page 32

PROCEDURES:

Read the reference articles.

QUESTIONS:

1. What did the mudflows do to trucks and machines?

2. What did the mudflows do to the log piles?

3. How did the mudflows affect people's travel in the valley?

4. Why is a low area next to the river a poor place to build?

5. How did mudflows affect ship traffic in the Columbia River?

LEVEL INFORMATION: SS MS, HS

VOLCANO EFFECTS IN COUGAR

OBJECTIVES:
The students will:

1. **Identify community needs given the unusual situation.**
2. **Devise various courses of action to fulfill these needs.**
3. **Test the various courses of action they have devised by means of role playing.**

TEACHER BACKGROUND:

The following article excerpts presents the emergency action taken by the state of Washington in view of the continuing activity of Mount St. Helens. The formation of the Red Closure Zone created problems and concerns for many area residents. The excerpts in this activity present some of the problems with a focus on the small community of Cougar, Washington. These are arranged in chronological order and should be reproduced for student use. The excerpts are arranged so that you may have the students perform the activities at various stages in the sequence giving only the information necessary.

ACTIVITY I

VOLCANO EFFECTS IN COUGAR

REFERENCE ARTICLES:

— "Dust driving longtime Cougar residents out," Page 21
— "Humor high despite trials and hardships," Page 33
— "Cougar residents flee, Page 45

PROCEDURE:

Read the following newspaper excerpts about Cougar, Washington. Locate Cougar on the map on page 29.

Excerpt I:

During the past 48 hours a mile-wide slab of rock and ice on Mount St. Helens has grown more unstable, fueling fears that tons of debris could crash down on the land below at any time.

That report from the U.S. Geological Survey scientists came at the same time Gov. Dixy Lee Ray signed an executive order closing Spirit Lake Highway from the mountain to a point 15 miles east of I-5.

The emergency order signed at 12:30 this afternoon prohibits anyone from entering a designated red zone around the mountain in a five-mile radius to the south, east and west of the peak. The area to the north includes the Mount Margaret area and all of Spirit Lake. The only persons allowed in the red zone are scientists and law enforcement personnel. Private property owners are banned.

A second area — the blue zone — extends five miles around the red zone and includes most of Spirit Lake Highway to a point 15 miles east of I-5. Commercial logging operations will be allowed during the daytime only.

Property owners are allowed to enter only by special permit.

State law says anyone violating this order would be subject to a $500 fine and/or six months in jail. The State Department of Transportation is currently erecting iron pole gates across the road at the Cowlitz-Skamania county line and at a point eight miles west of the county line. The gates will be locked and scientists, the State Patrol and county sheriff's officers will have keys.

Even an eruption at Mount St. Helens can't melt state red tape. The Cowlitz County Sheriff's Department will have t[o] wait for the state to help man roadblocks near the erupting 9,677-foot peak because the county failed to follow state regulations.

"The county didn't do anything wrong," Chow said. "It just didn't do enough to satisfy the state regulations.' "

THE DAILY NEWS, Longview, Wash., April 1, 1980

Excerpt II:

COUGAR -- National guardsmen armed with guns but no bullets stood watch at a new roadblock five miles west of here Saturday. They turned back tourists bent on a once-in-a-lifetime glimpse of erupting Mount St. Helens.

Several Cougar residents and business owners were fuming because the roadblock was cutting off their lifeline of tourist trade — with or without an erupting volcano. The roadblock had been moved early Saturday from east of town to west of town and it was keeping people — and their money — away.

Some residents, however, welcomed the roadblock fearing that the glut of roving outsiders this last week would cause traffic jams if an emergency evacuation became necessary.

One businesswoman threatened to consult an attorney Monday if the roadblock was not removed. "We plan on going to see an attorney and getting an injunction," Sandy Mortenson, co-owner of the Wildwood Inn, said.

THE COLUMBIAN, April 6, 1980

Excerpt III:

A volcano-caused flood would be much the same as a spring flood to county emergency workers.

But a mudflow — far less likely than mere rising water — could be more difficult than a flood, said Nolan Lewis, Cowlitz County's emergency services director.

THE DAILY NEWS, Longview, Wash., April 12, 1980

Excerpt IV:

Is that all there is to Mount St. Helens?

The mountain showed little change Thursday, remaining in its becalmed state with an occasional hefty earthquake sending seismologists to study their graph machines.

THE DAILY NEWS, Longview. Wash./AP April 18, 1980

Excerpt V:

STEVENSON — A small property tax protest has erupted on the side of the volcano at Mount St. Helens, Skamania County Treasurer Katherine Wright said Thursday.

Three angry cabin owners in the Spirit Lake area have refused by letter to pay their 1980 property taxes because they aren't being allowed on the land, she said, adding that several other letters received during the past few days contained tax payments, but protest statements also were enclosed.

THE COLUMBIAN, May 2, 1980

Excerpt VI:

COUGAR — Four miles east of here is a roadblock that many people wish was not there. But such is the consequence of a restless volcano.

"I think people are getting kind of tired of it now. They want to go back and live their lives. The novelty has worn off," said Linda Elmire, a clerk at the Cougar Store.

"Everybody wishes all the roadblocks would come off — and the fishing,' she said."

THE COLUMBIAN, May 4, 1980

Excerpt VII:

Three little words make a world of difference for Marge Olson's cafe-tavern along the Lewis River below Mount St. Helens.

To drive to her Beaver Bay Cafe, people must pass a sign in Cougar, three miles to the west, that says "Local Traffic Only." But drivers don't encounter a roadblock until they pass Mrs. Olson's cafe.

"My business is almost killed because of that sign," Mrs. Olson said.

"If it's so dangerous and so terrible up here, why are people working in the area?" Loggers and Forest Service workers are allowed past the roadblock during daylight hours.

THE DAILY NEWS, Longview, Wash., May 14, 1980

Excerpt VIII:

Cowlitz County Sheriff Les Nelson said this morning that private search parties in the disaster area may have been caught by Sunday morning's ash fallout.

Nelson also took issue with the people who have criticized the official rescue operations as well as those involved in the private search parties.

"I understand and I sympathize with those people who have lost loved ones, but people have to appreciate that there is a way to do these things," he said. "The people who throw a pack on their back and go in there are actually contaminating the rescue scene."

Nelson said there was some confusion among the many agencies involved in search and rescue efforts. "But you show me where they've handled a volcanic eruption better. It's not fair to criticize people who have worked this hard"

THE DAILY NEWS, Longview, Wash., May 26, 1980

Excerpt IX:

"We've already filled out waivers that we wouldn't sue the state or the county. We're just redoing the same thing. It's just the governor's orders, and she isn't going to get many votes this year." — Linda Dobbins of Yale

Dozens of Cougar, Yale and Ariel residents were kept waiting hours Tuesday in the lobby of the Vancouver office of the state Department of Licensing as they sought permission to go home.

Several persons arrived as early as 9 a.m. to get their permits for entry into the designated "red zone" around Mount St. Helens.

THE COLUMBIAN, June 11, 1980

Excerpt X:

COUGAR — Dot and Elvin Elmire finally have relented to the wrath of Mount St. Helens and left their Cougar Store.

"Heck, without our power, we're just kind of dangling," said Mrs. Elmire, who up until this morning had chosen to stay 12 miles southwest of the capricious cone that blew sky high.

THE COLUMBIAN, June 13, 1980

Excerpt XI:

COUGAR — They sat up all night at Jack's Sporting Goods store in Cougar as pea-sized pumice fell outside. 15 defiant souls who still say they aren't afraid of erupting Mount St. Helens.

"The sheriff started to evacuate us, but it was too dangerous to drive so everybody stopped at our place." That was Jean Ragsdale who answered when The Daily News called this morning. She and her husband own Jack's Sporting Goods in Cougar, and they'd had no sleep all night.

THE DAILY NEWS, Longview, Wash., June 13, 1980

Excerpt XII:

Residents of the Cougar area, clamoring to get their towns and nearby recreation areas southwest of Mount St. Helens reopened to the public, "are hearing only what they want to hear," says an official who himself was chased out of his home and office by the volcano.

THE COLUMBIAN, June 24, 1980.

ACTIVITY I — COMMUNITY NEEDS

1. Cougar had some real concerns about their welfare as a community. List some of their concerns below for the following dates.

April 1 — April 18:

No tourist trade, traffic jams outside roadblocks

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May 2 — May 14:

Won't pay taxes, bored by volcano, no business, loggers can work, but tourists can't come in

May 26 — June 24:

Critical of the rescue effort, permission slips slow, people move out, solidarity of community — show no fear, need to get area reopened

2. Do the stories written by the press suggest a course of action for those needs?
Choose one of the needs or problems. Give your answer in two parts
1. The resulting action which can be taken by the government.
2. Resulting action that could be taken by the citizens.
1. Government:
2. Citizens:

ACTIVITY II — COURSE OF ACTION

Choose a course of action devised from activity 1. Role play the action to determine whether it is workable. If not, then revise the course of action.

ACTIVITY III — SITUATIONS

1. Some people decided to move out of Cougar; others decided to stay. Have two people role play following situations:

Person 1:

A. Business is gone, decides to move out in spite of savings
B. Student from Cougar who is leaving after spending all his life there.
C. Father of family wants to leave because of no business.
D. Sheriff who came to evacuate Jack's Sporting Goods Store.

Person 2:

A. Business is gone, stays in town, living on savings.
B. Student from Cougar who must be evacuated only to find hours of waiting before he can return.
C. Mother of family wants to stay despite no business.
D. A person in the store during the pumice "rain."

NAME: _____ DATE: _____

ACTIVITY I — CONCERNS

REFERENCE ARTICLES:

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April 1 — April 18:

May 2 — May 14:

May 26 — June 24:

2. Do the stories written by the press suggest a course of action for those needs? Choose one of the needs or problems. Give your answer in two parts
1. The resulting action which can be taken by the government.
2. Resulting action that could be taken by the citizens.

1. Government:

2. Citizens:

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NAME: _____ DATE: _____

ACTIVITY II — COURSE OF ACTION

Choose a course of action from Activity 1. Role play the action to determine whether it is workable. If not, revise the course of action.

NAME: _____ DATE: _____

ACTIVITY III — SITUATIONS

1. Some people decided to move out of Cougar; others decided to stay. Have two people role play following situations:

Person 1:

A. Business is gone, decides to move out in spite of savings
B. Student from Cougar who is leaving after spending all his life there.
C. Father of family wants to leave because of no business.
D. Sheriff who came to evacuate Jack's Sporting Goods Store.

Person 2:

A. Business is gone, stays in town, living on savings.
B. Student from Cougar who must be evacuated only to find hours of waiting before he can return.
C. Mother of family wants to stay despite no business.
D. A person in the store during the pumice "rain."

LEVEL INFORMATION: SS, LA MS, HS

HARRY TRUMAN — HEROIC OR FOOLHARDY?

OBJECTIVE:

After reading several articles on Harry Truman the students will participate in a class discussion and write a paper on the topic "Harry Truman, Heroic or Foolhardy?"

TEACHING SUGGESTIONS:

After reading the articles concerning Harry Truman, discuss the man, his actions and the public's reaction to him with the class. Be sure to point out that not everyone thought he was a hero.

Guide questions:

1. **Would you have stayed at Spirit Lake? Why?**
2. **Should Harry have been forced to leave? Why?**
3. **Why do you think everyone else had to leave when Harry was allowed to stay?**

ACTIVITY III

Play a number of ballads in the class — explain that ballads tell a story about a folk hero, human or not, much as Harry Truman is today. Suggested ballads are "Ode to Big Blue," "Edmund Fitzgerald" and "Miguel" By Gordon Lightfoot; "Ode to Billie Joe" by Bobbie Gentry; and "Gilgarra Mountain" by Peter, Paul and Mary." The students may wish to use existing music and read the words. This could be done as a class activity or in small groups.

HARRY TRUMAN — HEROIC OR FOOLHARDY?

REFERENCE ARTICLES:

— "Fame just so much 'hooey'," Page. 38
— " 'Copter jumps the gun, Harry stays put," Page 38
— "Harry Truman lived and died by his rules," Page 39
— "Friends remember with laughter, tears," Page 39
— "Spirit Lake always," Page 39
— "Harry Truman Lake," Page 39

PROCEDURE:

After reading the reference articles break into groups of four to five. Discuss possible answers to the following questions. The answers will be used as background for the three activities.

1. What things were important to Harry Truman?

2. Find the word "immunity" in a dictionary. Write a definition below. Harry was given immunity from the law and allowed to stay at his lodge. You have been given shots to give you immunity from some disease. List below what you are immune to.

I'm immune to:

3. One could say Harry was dedicated to Mount St. Helens. Why?

4. Give reasons why Harry might not have told anyone the real reason he did not want to leave Mount St. Helens.

5. List the reasons Harry gave for staying. Can you justify them?

ACTIVITY I — WRITE TO HARRY TRUMAN

Some existing knowledge of letter writing is preferred, although the purpose of this activity is to take a position and support it. When you have finished discussing the questions, write a letter to Harry Truman expressing your opinion about his ultimate choice. Give reasons for your opinions. Include the ideas from the questions above. Remember to begin your letter with "Dear Mr. Truman," and close your letter, "Sincerely, (your name)"

ACTIVITY II

Ask for volunteers within the classroom. Allow the presenters time to formulate and support their opinions. Other questions concerning Harry Truman could also be discussed. For instance, should Harry have kept his cats with him? Should Spirit Lake Lodge be rebuilt?

Read the two letters on Page 39, "Harry Truman Lake" and "Spirit Lake Always." Have a panel discussion about Harry Truman. Appoint a moderator and five panel members for each side of this issue. Should the abbreviated Spirit Lake of today be renamed Harry Truman Lake?

ACTIVITY III — WRITE A BALLAD

After listening to the ballads, write one about Harry Truman, set to music if possible.

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NAME: _____ DATE: _____

HARRY TRUMAN — HEROIC OR FOOLHARDY?

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NAME:_____ DATE:_____

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NAME: _____ DATE: _____

ACTIVITY III — WRITE A BALLAD

After listening to the ballads, write one about Harry Truman, if possible, set to music.

LEVEL INFORMATION: LA, SCI MS, HS

WHAT HAPPENED TO THE ANIMALS?

OBJECTIVES:
The students will:
1. Name the animals around Mount St. Helens and list the conditions they existed under before and after the May 18, 1980 eruption.
2. Write a story from the animal's point of view about the eruption and its effects.

TEACHING SUGGESTIONS:
1. Ask the students to read the reference articles.
2. Help the class pick one animal and lead a discussion about how its life changed after the eruption.
3. Draw three columns on the chalkboard as follows:

ERUPTION EFFECTS ON ANIMALS

Animal	Before	After

4. Help the students make lists of animals living near the mountain. Talk about what it was like before the eruption and contrast that with what it was like after the eruption.
5. Tell the students to choose one animal on the list and write a story from the point of view of the animal about what happened to it after the eruption. Tell them to include information about things such as food, shelter, young, habitat, age, physical characteristics.
6. Tell students who have written about the same animal to form a group and read other's stories. Or you may prefer to ask for volunteers to read their stories to the class — ask for stories about different animals.

WHAT HAPPENED TO THE ANIMALS?

REFERENCE ARTICLES:
— "Fish, game lost," Page 46
— "Toll of fish put at 10 million Page 46
— "Gloomy prediction . . ." Page 47
— "Timber loss wipes out home for species," Page 47
— "Bird and animal toll 1.5 million," Page 47

PROCEDURE:
1. Read the reference articles in "Mount St. Helens."
2. Participate in class discussion about the effects of the Mount St. Helens eruption on wildlife.
3. Choose one animal from the list and write a story from the point of view of the animal about what happened to it after the eruption. Include such things as food, shelter, young, habitat, age, physical characteristics.
4. Participate in a discussion of the stories.

Stories will vary. They should show much thought.

NAME: _____ DATE: _____

WHAT HAPPENED TO THE ANIMALS?

REFERENCE ARTICLES:

— "Fish, game lost," Page 46
— "Toll of fish put at 10 million
— "Gloomy prediction . . ." Page 47
— "Timber loss wipes out home for species," Page 47
— "Bird and animal toll 1.5 million," Page 47

PROCEDURE:

1. Read the reference articles in "Mount St. Helens."
2. Participate in class discussion about the effects of the Mount St. Helens eruption on wildlife.
3. Choose one animal from the list and write a story from the point of view of the animal about what happened to it after the eruption. Include such things as food, shelter, young, habitat, age, physical characteristics.
4. Participate in a discussion of the stories.

LEVEL INFORMATION: LA, SS MS, HS

JOBS OF THE PEOPLE, FOR THE PEOPLE, BY THE PEOPLE

OBJECTIVE: The students will:

1. Describe the occupations and points of view of the people connected directly or indirectly with Mount St. Helens.
2. Select one occupation and role play it, demonstrating the point of view of the occupation.

TEACHING SUGGESTIONS:

1. The students should begin to see that all the jobs including the geologists are people related.
2. Divide the class into small groups. Give each group a section of the student tabloid to read. All sections have people and their jobs described.

Here is a partial list of jobs and employers alluded to in the articles:

Seismologist
Geologists
National Guard
Federal Emergency Management Agency
State Patrol
Dept. of Ecology
Newspaper
Ham radio operators
Fire fighters
Television reporters and technicians
Pilots
Red Cross
Doctors
Port of Portland
Mental Health Center
Loggers
Sheriff's Dept.
Coroner
U.S. Forest Service

Possible categories include:

1. Federal, state, local employers
2. Mudflow, ash fall, blast etc. related work
3. On the mountain, off the mountain workers
4. Reporting the events.

You will think of others.

JOBS OF THE PEOPLE, FOR THE PEOPLE, BY THE PEOPLE

ACTIVITY — JOBS

1. Individually read the section of "Mount St. Helens" assigned to your group, then do steps 2 through 5 as a group.
2. Make a list of the people associated directly or indirectly with the eruption of Mount St. Helens. List their exact job and their employers, where possible. Be as specific as possible.
3. Categorize your list in some way (by kind of job or by employer, for instance).
4. Make another list of the things all the jobs have in common.
5. Choose one of the categories you identified in Step 3. Describe all the job holders in that category by filling in the chart on Worksheet 1.
6. Individually, select one person on the chart you would like to interview. Write a list of questions you would ask this person if you could. Prepare your interview on the form below:

A review of the 5 Ws and H might be helpful here.

ACTIVITY II — ROLE PLAY

PROCEDURE:

1. In your group, list two or more job roles on Worksheet 2 that especially interest you and that you think are well described. Complete Worksheet 2 by listing the similarities and differences of the jobs, and by stating the attitude each has toward disaster.
2. For five minutes, brainstorm situations in which the jobholders have an interaction.
3. Choose one situation discussed in Step 2 to role play for the class. If the points of view of the roles being played are different the role play may be more interesting.

NAME: _____ DATE: _____

JOBS OF THE PEOPLE, FOR THE PEOPLE, BY THE PEOPLE

ACTIVITY I — JOBS

1. Individually read the section of "Mount St. Helens" assigned to your group, then do steps 2 through 5 as a group.
2. Make a list of the people associated directly or indirectly with the eruption of Mount St. Helens. List their exact job and their employers, where possible. Be as specific as possible.
3. Categorize your list in some way (by kind of job or by employer, for instance).
4. Make another list of the things all the jobs have in common.
5. Choose one of the categories you identified in Step 3. Describe all the job holders in that category by filling in the chart on Worksheet 1.
6. Individually, select one person on the chart you would like to interview. Write a list of questions you would ask this person if you could. Prepare your interview on the form below:

Person: _____

Job: _____ Employer: _____

Questions:

1. _____

2. _____

3. _____

4. _____

5. _____

NAME: _____ DATE: _____

WORKSHEET No. 1

CATEGORY: _____

EMPLOYER	JOB	DESCRIPTION	POINT OF VIEW OF THE JOBHOLDER

NAME:_____ DATE:_____

GROUP:_____

ACTIVITY II — ROLE PLAY

PROCEDURE:

1. In your group, list two or more job roles on Worksheet 2 that especially interest you and that you think are well described. Complete Worksheet 2 by listing the similarities and differences of the jobs, and by stating the attitude each has toward disaster.
2. For five minutes, brainstorm situations in which the jobholders have an interaction.
3. Choose one situation discussed in Step 2 to role play for the class. If the points of view of the roles being played are different the role play may be more interesting.

NAME: _____ DATE: _____

WORKSHEET No. 2:

JOBS PEOPLE HAVE

JOBS	HOW ALIKE	HOW DIFFERENT	ATTITUDE TOWARD DISASTER

LEVEL INFORMATION: LA, SS MS, HS

BOOM TO BOON

OBJECTIVES:
The students will:
1. List ways the Mount St. Helens eruption is being used for commercial gain.
2. Analyze a news article to determine approach being used to sell the produce.
3. Create an ad campaign for a Mount St. Helens related product.

TEACHING SUGGESTIONS:
1. Present various advertising devices to the class. Explain that this is often how newpapers are sold.
2. Help the students complete Steps 1-5 on the Activity Sheet.
3. Explain that entrepeneurs (one who organizes, manages and assumes the risks of a business or enterprise) use many approaches to people in their efforts to sell their product. These include:
   a. Purposeful distortion.
   b. Ambiguity — suggesting much, saying little
   c. Appeal — desire to be strong, desire to be attractive, desire to be up-to-date.
   d. Emotion — fear, hope, grief.
   e. Cherished values — the good, the true, the beautiful
   f. Name calling — Yankee, Rebel, Sissy
   g. Glittering generalities — religious, science, brotherhood.

List the approaches on the chalkboard.

4. Ask the students to analyze one of the news articles listed to determine which of the above approaches they can discover. If none of these approaches apply, see if the class can identify another approach to add to the list. (Step 6 on the activity sheet).
5. Help the students prepare an advertising promotional campaign for the State of Washington to show that it has not been devastated by Mount St. Helens (Step 7 on the activity sheet).

BOOM TO BOON

REFERENCE ARTICLES:
— "Volcano gives rise to a business boom," Page 49
— "A bumper crop of stickers," Page 49
— "T-shirts, T-shirts, still more T-shirts," Page 49
— "Some people find ash has some use after all," Page 49
— Photo, assorted St. Helens items, Page 49

PROCEDURE:
1. Read the "business boom" articles on Page 49 of "Mount St. Helens." Make a list, in the two listed categories, of the ways entrepreneurs have made money from the eruption.

Materials Sold Directly from Mountain	Materials Sold Indirectly from Mountain	
Airlines	T-Shirts	calendar
cleanser	post cards	face mask
ashtray	posters	records
pendant	books	bumper stickers

2. List other ways to make money using ash or using non-volcanic material. For example, plaster of Paris volcanoes, painted and labeled. If there is time, draw a picture or make an example of your products you like best.

Answers vary

3. What items are available in your area that are comparable to the Mount St. Helens items?

Answers vary

a. Are the features you've listed unique to your area? If no, where else could they be found?

Answers vary

4. List any other items you feel your area could sell. If there is time, draw a picture or perhaps bring a model to display.

Answers vary

5. Do you think the items you have listed in Question 3 are intended mainly for the resident population or for tourists? Why?

Answers will vary

6. Select one of the articles in the reference articles list. Which of the selling approaches listed on the chalkboard do you think is used? If none of the approaches apply, what approach do you think is being used?

Answers will vary.

7. Create an ad campaign for the state of Washington to show that it has not been devastated by the eruption of Mount St. Helens. Here are a few suggestions.

a. Think of the type(s) of media you want to use, i.e. radio, TV, news, magazine.
b. Consider the potential receivers of your campaign.
c. Check out the costs of advertising in your media choices vs. the cost of production.
d. Decide where your campaign will be carried out.

Your ad campaign should include the following:

a. The cost of production.
b. The cost of the media exposures.
c. A makeup of your ad(s).
d. Duration of exposure.
e. Area of geographic exposure.

NAME: _____ DATE: _____

BOOM TO BOON

REFERENCE ARTICLES:

— "Volcano gives rise to a business boom," Page 49
— "A bumper crop of stickers," Page 49
— "T-shirts, T-shirts, still more T-shirts," Page 49
— "Some people find ash has some use after all," Page 49
— Photo, assorted St. Helens items, Page 49

PROCEDURE:

1. Read the "business boom" articles on Page 49 of "Mount St. Helens." Make a list, in the two listed categories, of the ways entrepreneurs have made money from the eruption.

Materials Sold Directly from Mountain	Materials Sold Indirectly from Mountain

2. List other ways to make money using ash or using non-volcanic material. For example, plaster of Paris volcanoes, painted and labeled. If there is time, draw a picture or make an example of your products you like best.

3. What items are available in your area that are comparable to the Mount St. Helens items?

Are the features you've listed unique to your area? If no, where else could they be found?

4. List any other items you feel your area could sell. If there is time, draw a picture or perhaps bring a model to display.

5. Do you think the items you have listed in Question 3 are intended mainly for the resident population or for tourists? Why?

6. Select one of the articles in the reference articles list. Which of the selling approaches listed on the chalkboard do you think is used? If none of the approaches apply, what approach do you think is being used?

7. Create an ad campaign for the state of Washington to show that it has not been devastated by the eruption of Mount St. Helens. Here are a few suggestions.

a. Think of the type(s) of media you want to use, i.e. radio, TV, news, magazine.
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d. Decide where your campaign will be carried out.

Your ad campaign should include the following:

a. The cost of production.
b. The cost of the media exposures.
c. A makeup of your ad(s).
d. Duration of exposure.
e. Area of geographic exposure.

DEMONSTRATION: DISSOLVED OXYGEN

OBJECTIVES:
The students will:
1. Discuss the relationships among dissolved oxygen, temperature and turbidity with life in the water.
2. Construct a graph showing the relationship between temperature and dissolved oxygen.

TEACHING BACKGROUND:
Gases such as oxygen and carbon dioxide are held in water by a phenomenon called hydrogen bonding. This is the name given to the bond which is a result of the attraction of the hydrogen atoms of water to certain other atoms such as oxygen. As the water temperature increases, the distance between water molecules increases and their relative motion becomes greater. This greater motion and wide dispersement of the water molecules weakens the hydrogen bonds. This results in fewer oxygen molecules being attracted to the hydrogen atoms, which in turn means a lower dissolved oxygen content. As the water cools, the attraction between molecules will become greater and the amount of dissolved oxygen will increase.

TEACHING SUGGESTIONS:
1. Lead class in discussion, focusing on the following points:
   A. Nearly all life needs oxygen.
   B. Most aquatic animals use gills to extract dissolved oxygen from water.
2. With the dissolved oxygen activity help students to discover that dissolved oxygen will decrease as the water temperature increases.
3. Follow-up discussion.
Discuss results of activity. Students should see that the amount of dissolved oxygen will decrease as water temperature increases. Discuss the effect this would have on the Toutle and Cowlitz Rivers and what it might mean for the future of the rivers.

DISSOLVED OXYGEN DEMONSTRATIONS:
1. Write your prediction under Question 1 on the worksheet.
2. Put 300ml cold tap water in a blender and blend at top speed for one minute.
3. Then take the temperature of the sample of water and record it on the data table under Question 2 on the worksheet. Students may help take the water temperatures.
4. Following the directions in the Dissolved Oxygent Kit, carefully determine the dissolved oxygen and record the results on the table. WARNING: STUDENTS MUST NOT BE ALLOWED TO DO THIS EXPERIMENT BECAUSE OF THE DANGEROUS CHEMICALS INVOLVED.
5. Repeat steps 2, 3 and 4 three times, using water of different temperature each time. The last sample should be very hot to the touch. Record the data on the table below.
6. Plot the results on the graph to show the relationship.

DISSOLVED OXYGEN

REFERENCE ARTICLES:
— "Toll of fish put at 10 million," Page 46
— " Fish, game lost," Page 46
— "Fish brave muddy Cowlitz," Page 46
— "Timber loss wipes out home for species," Page 47
— "Gloomy prediction: Silica lodges in salmon gills and 'cuts them to shreds' ," Page 47

PROCEDURE:
1. Predict what will happen to the dissolved oxygen as the temperature of the water increases. Record your prediction under Question 1 on the worksheet.
2. Record the temperature of the water sample on the "Temperature degrees Celsius" line in the graph - Question 2.
3. Watch your teacher's demonstration of the measurement of Dissolved Oxygen. Record the result on the "Dissolved Oxygen ppm" line in the graph, Question 2. **CAUTION: STUDENTS MUST NOT ATTEMPT THIS EXPERIMENT. SULFURIC ACID AND ALKALINE IODIDE ARE FAR TOO DANGEROUS.**
4. Plot the results on the graph, Question 2.
5. Use the data table or the data generated by the teacher's demonstration to answer questions three to six on the worksheet.

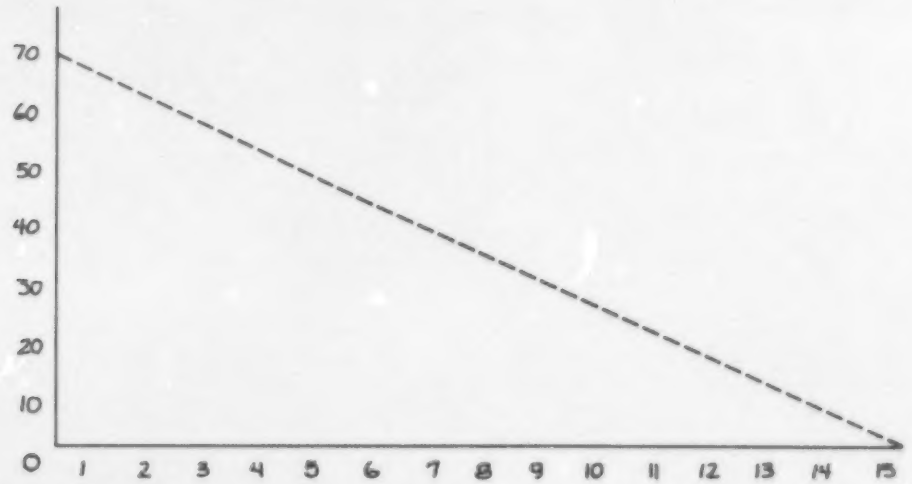
QUESTIONS:
1. Prediction: As the temperature of water increases, the amount of dissolved oxygen will (check one):

Increase ☐	Stay the same ☐	Decrease ☒

2. Data table and graph

DATA TABLE

Sample	1	2	3	4
Temperature (Celsius)				
Dissolved 0_2 ppm				



3. Would ice water or warm water have more dissolved oxygen?

Ice water

4. Which would fish prefer? Why?

Most fish prefer ice water because it holds more oxygen.

5. How might the hot mud and ash have affected the fish population of the Toutle and Cowlitz rivers?

In the Toutle and Cowlitz the high temperature of the water, the reduced oxygen content, and other factors would have killed most or all life.

6. What might happen to the river in the future if no dams are built?

Life will have to be re-established over the years. Flooding and dredging are also likely to occur. The river will basically remain dead over the next several years.

7. What if dams are built?

Risk of flooding will decrease.
Life will be established more quickly.

EXTENDED STUDY

1. Have students determine ways oxygen gets back into the water.
Cool temperature, shaking, agitation which stimulates rapids and turbulence.

NAME: _____ DATE: _____

DEMONSTRATION: DISSOLVED OXYGEN

REFERENCE ARTICLES:

— "Toll of fish put at 10 million," Page 46
— " Fish, game lost," Page 46
— "Fish brave muddy Cowlitz," Page 46
— "Timber loss wipes out home for species," Page 47
— "Gloomy prediction: Silica lodges in salmon gills and 'cuts them to shreds' ," Page 47

PROCEDURE:

1. Predict what will happen to the dissolved oxygen as the temperature of the water increases. Record your prediction under Question 1 on the worksheet.
2. Record the temperature of the water sample on the "Temperature degrees Celsius" line in the graph - Question 2.
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QUESTIONS:

1. Prediction: As the temperature of water increases, the amount of dissolved oxygen will (check one):

Increase ☐ Stay the same ☐ Decrease ☐

2. Data table and graph

DATA TABLE

Sample	1	2	3	4
Temperature (Celsius)				
Dissolved O_2 ppm				

3. Would ice water or warm water have more dissolved oxygen?

4. Which would fish prefer? Why?

5. How might the hot mud and ash have affected the fish population of the Toutle and Cowlitz rivers?

6. What might happen to the river in the future if no dams are built?

If dams are built?

EXTENDED STUDY

1. Have students determine ways oxygen gets back into the water.

LEVEL INFORMATION: LA, SCI MS, HS

AFTER THE HOLOCAUST — WHAT THEN?

OBJECTIVE:

The student will search "Mount St. Helens" for supporting facts to write a paragraph summarizing the effects of the Mount St. Helens eruption on a student-selected aspect of nature.

TEACHING SUGGESTIONS:

1. The activity may be done individually or by pairs of students.
2. There are five tasks to be completed in the activity.
   a. Select a topic
   b. Search "Mount St. Helens" for information on the topic.
   c. Make notes of the information to be used in writing the paper, or underline the facts to be used.
   d. Organize the facts to be used in the paper
   e. Write the paper
3. Help the students compare the tasks in the activity.
4. The students may need some extra help in identifying and recording facts they want to use in writing their articles. They also may need some encouragement to skim the articles instead of reading the article in its entirety. You may want to provide guidelines for scanning, underlining and note taking. You may also want to review the difference between a fact and an opinion.

AFTER THE HOLOCAUST — WHAT THEN?

REFERENCE ARTICLES:

— Selected by the student from the "Mount St. Helens" tabloid.

PROCEDURE:

1. Select a topic from the list below that is of interest to your and that you would like to write about.
   - Forests
   - Wildlife and fish
   - Waterways and lakes
   - Health of people/mental and physical
   - Effects on people who live in or near Toutle
2. Search through your copy of "Mount St. Helens" to find articles about the effects of the volcano on the topic you selected.
3. Scan the articles you found to identify facts concerning the effects of the eruption on your topic. Write down the facts.
4. Decide which facts you want to use in your paper. Set the other facts aside — you may decide to use some of them as you start writing.
5. Organize your notes into a basic outline for your paper. You may want to use the following headings:
   a. The damage done.
   b. The recovery period.
   c. Anticipated future problems.
   d. Various opinions, such as: whether man should interfere to help; whether nature should be allowed to take its course; what is helpful or not helpful; or what will block recovery.
6. Write the paper, including an introduction, the main facts and a conclusion.

EXTENDED ACTIVITY:

Form a group with others in the class who wrote about the same topic. Share your papers. Discuss different facts you used, why you selected some facts and not others, how your papers are similar.

NAME: _____ DATE: _____

AFTER THE HOLOCAUST — WHAT THEN?

REFERENCE ARTICLES:
— Selected by the student from the "Mount St. Helens" tabloid

PROCEDURE:
1. Select a topic from the list below that is of interest to your and that you would like to write about.
- Forests
- Wildlife and fish
- Waterways and lakes
- Health of people/mental and physical
- Effects on people who live in or near Toutle

2. Search through your copy of "Mount St. Helens" to find articles about the effects of the volcano on the topic you selected.

3. Scan the articles you found to identify facts concerning the effects of the eruption on your topic. Write down the facts.

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   a. The damage done.
   b. The recovery period.
   c. Anticipated future problems.
   d. Various opinions, such as: whether man should interfere to help; whether nature should be allowed to take its course; what is helpful or not helpful; or what will block recovery.

6. Write the paper, including an introduction, the main facts and a conclusion.

NAME: _____ DATE: _____

EXTENDED ACTIVITY:

Form a group with others in the class who wrote about the same topic. Share your papers. Discuss different facts you used, why you selected some facts and not others, how your papers are similar.

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LEVEL INFORMATION: LA MS, HS

SIMILE: IT'S LIKE, OR IT'S THE SAME AS . . .

OBJECTIVE:
Students will focus on vocabulary words related to the volcano by doing the activity prescribed.

TEACHING SUGGESTIONS:
1. Review the definition of similes with the class. Use two or three words from the volcanic word list and help the students supply a simile for each one.
2. Instruct the students to complete the chart printed on the Activity Sheet.
3. Tell the student select three of their five similes and write a short story that contains the word, and its simile.
4. Form small groups of students. Tell them to read their stories to each other and decide whether the similes and their usage is correct. Be available to help the groups do this work.

IT'S LIKE, OR IT'S THE SAME AS . . .

REFERENCE ARTICLES:
— "Glossary of Volcanic Terms," Page 51

MATERIALS:
Dictionary

PROCEDURE:
1. Participate in a class discussion about similes.

2. Select five volcanic words in the list below. Write a simile for each selection. Get help from the dictionary and from the Glossary on Page 51 of "Mount St. Helens."

Volcanic	Simile
Cone	
Core	
Crater	
Crust	
Debris	
Deposit	
Dislodge	
Earthquake	
Eruption	
Fissure	
Fumarole	
Glowing ash	
Juvenile ash	
Lateral	
Lava flows	
Magma	
Mantle	
Molten	
Mudflow	
Pressure	
Pumice	
Pyroclastic	
Sequence	
Summit	
Vent	
Volcano	

3. Select three of the five similes you have just written and weave them into a story. Use **both** the word and its simile.

Answers will vary.

4. Read your story to others in the group. Listen to the others. Participate in a discussion about how well everyone used similes in their stories.

Discussion should give evidence of understanding similes.

NAME: _____ DATE: _____

SIMILE: IT'S LIKE, OR IT'S THE SAME AS . . .

REFERENCE ARTICLES:
— "Glossary of Volcanic Terms," Page 51

MATERIALS:
Dictionary

PROCEDURE:
1. Participate in a class discussion about similes.

2. Select five volcanic words from the list below. Write a simile for each selection. Get help from your dictionary and from the Glossary on page 51 of "Mount St. Helens."

Volcanic	Simile
Cone	
Core	
Crater	
Crust	
Debris	
Deposit	
Dislodge	
Earthquake	
Eruption	
Fissure	
Fumarole	
Glowing ash	
Juvenile ash	
Lateral	
Lava flows	
Magma	
Mantle	
Molten	
Mudflow	
Pressure	
Pumice	
Pyroclastic	
Sequence	
Summit	
Vent	
Volcano	

3. Select three of the five similes you have just written and weave them into a story. Use both the word and its simile.

4. Read your story to others in the group. Listen to the others. Participate in a discussion about how well everyone used similes in their stories.

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LEVEL INFORMATION: LA MS, HS

HOW DOES IT LOOK TO YOU?

OBJECTIVE: The students will write a descriptive paragraph or paragraphs based on reading articles chosen from "Mount St. Helens."

TEACHING SUGGESTIONS:

1. Help the class select four or five articles from the reference articles List and ask the students to read them.

2. Help the students list on the chalkboard, butcher paper or chart all the words in the articles they can remember that describe the mountain. Encourage them to think of additional adjectives. Another method which may be helpful is to fill in a chart (see example below).

Kind of word	Nouns	Verbs	Adjectives	Adverbs
Feeling words	1. Queen of the Cascades 2. Harmony Forest 3. Spirit Lake 4. Victim	Evacuated	exciting hurting cantankerous	
Sight Words	1. Picture postcards 2. Snow-capped peak 3. Cracks	shakes	gray and dark	
Sound Words	1. Echo	rumbles boom	loud	Softly

3. Tell the students to use the words they listed as the basis for a paragraph that describes:
- **how they feel about the mountain, or**
- **how they think the mountain looks, or**
- **how they think the eruptions and earthquakes sounded.**

You and the class may think of other ideas for description.

4. Ask the students to share their paragraphs. Conduct a discussion about the great variety of ways in which Mount St. Helens can be described.

HOW DOES IT LOOK TO YOU?

REFERENCE ARTICLES:
- — Poem, Page 14
- — "Beautiful valley now desolate wasteland," Page 18
- — "Scientists study effects of ash closely," Page 19
- — "Dust driving longtime Cougar residents out," Page 21
- — "St. Helens viewpoint needed," Page 25
- — "Humor high despite trials and hardships," Page 33
- — "Scientists watch dome for lava flow," Page 34
- — "Times 33: Guatemalans have learned to live with 33 volcanoes," Page 37
- — "Couple struggle for life," Page 40
- — "Volcano drills for students," Page 40
- — "Searching: Helicopters comb 'hell on earth' to find survivors," Page 41
- — "Cougar residents flee," Page 45
- — "Timber loss wipes out home for species," Page 47

PROCEDURE:

1. Participate in the selection of four or five stories from the reference articles and read the article chosen.

2. Contribute to the listing of words that describe Mount St. Helens. Offer words you remember from the articles, as well as other words you believe describe Mount St. Helens.

3. Write a paragraph about Mount St. Helens, using the list of words as a basis to:

- describe how you feel about the mountain, or
- how you think the mountain looks, or
- how you think the earthquakes and eruptions sounded.

Your class may list other topics. Write your paragraphs about only one of the topics.

4. Be ready to share your paragraph with others. Discuss ways in which your paragraphs are different from each other.

NAME: _____ DATE: _____

HOW DOES IT LOOK TO YOU?

REFERENCE ARTICLES:

— Poem, Page 14
— "Beautiful valley now desolate wasteland," Page 18
— "Scientists study effects of ash closely," Page 19
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PROCEDURE:

1. Participate in the selection of four or five stories from the reference articles and read the article chosen.
2. Contribute to the listing of words that describe Mount St. Helens. Offer words you remember from the articles, as well as other words you believe describe Mount St. Helens.
3. Write a paragraph about Mount St. Helens, using the list of words as a basis to:

- describe how you feel about the mountain, or
- how you think the mountain looks, or
- how you think the earthquakes and eruptions sounded.

Your class may list other topics. Write your paragraphs about only one of the topics.

4. Be ready to share your paragraph with others. Discuss ways in which your paragraphs are different from each other.

LEVEL INFORMATION: LA MS, HS

MUDFLOW POETRY

OBJECTIVE:
The students will write a poem using descriptive verbs, and adjectives.

TEACHING SUGGESTIONS:

1. This activity may be done by individuals or in any size group.
2. If the activity is done in a large group the words on individual worksheets should be the ones they like best from a group brainstorming activity.

After reading the reference articles and studying the photo listed in the reference section:

3. Brainstorm lists of nouns, verbs and adjectives.
4. Tell the students to work as a group to select combinations of words.
5. Write them on the board as sentences or phrases.
6. Continue this process by circling other words and combining them. Then write them on the board.
7. When the group has five or six sentences or phrases, ask the group to edit what they have written. Ask — are there repetitions? Do the words need to be more specific?
8. Help the students suggest changes and write them on the board.
9. When you and the students are satisfied with the poem, leave it on the board as a model and then ask the students to write their own. They may use the words on the board in new combinations and/or add new words of their own.
10. Make a classroom book of the poems created.

MUDFLOW POETRY

REFERENCE ARTICLES:

— "Ominous, eerie hush falls," Page 28
— "Tragedy's Toll . . .," Page 30
— Photo, Cowlitz and Toutle rivers, Page 29
— Photo, under mud, Page 29
— Rampage, Page 27

PROCEDURE:

1. Read the articles and study the photos listed in the reference section.

2. List nouns associated with mudflows (e.g. trees, blossoms).

3. List active verbs associated with mudflows (e.g. chokes, destroys).

4. List adjectives associated with mudflows (e.g. green, growing)

5. Participate in the group to write a class poem, by combining two words from each list into lines. For example,

Mud oozes around the trees and blossoms.

Chokes and destroys

What once was green and growing.

6. Write your own poem. Select the words you like best from the lists. Try to describe sounds, smells and touch as well as sight. What would you hear, smell, touch and taste, as well as see, in a mudflow?

7. Prepare your poem to put in the classroom book. You may want to illustrate your poem with a drawing or picture cut from a paper or magazine.

NAME: _____ DATE: _____

MUDFLOW POETRY

REFERENCE ARTICLES:
- "Ominous, eerie hush falls," Page 28
- "Tragedy's Toll . . .," Page 30
- Photo, Cowlitz and Toutle rivers, Page 29
- Photo, under mud, Page 29
- Rampage, Page 27

PROCEDURE:

1. Read the articles and study the photos listed in the reference section.

2. List nouns associated with mudflows (e.g. trees, blossoms).

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4. List adjectives associated with mudflows (e.g. green, growing)

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Mud oozes around the trees and blossoms.
Chokes and destroys
What once was green and growing.

6. Write your own poem. Select the words you like best from the lists. Try to describe sounds, smells and touch as well as sight. What would you hear, smell, touch and taste, as well as see, in a mudflow?

7. Prepare your poem to put in the classroom book. You may want to illustrate your poem with a drawing or picture cut from a paper or magazine.

FROM PICTURE TO STORY

OBJECTIVE:

The students will dictate to a teacher or aide a descriptive story based on pictures chosen from the "Mount St. Helens" tabloid.

TEACHING SUGGESTIONS:

1. Help the class select one or two pictures and two or three related articles from the Student Tabloid which they think have good story-writing possibilities. Tell the students to use their tabloids to help them list all the words the articles and pictures bring to mind while the teacher or aide writes the words on a chalkboard, butcher paper or chart.

2. Ask the students to describe what type of story they would like to write (scary, funny, serious)

3. Help the students relate to story structure, plot and style as they write a class story. This can be done by:

a. Teaching them basic story format and filling in the blanks on the basic story format worksheet model written on the board to get a basic outline before writing.

b. Questioning students as to the "sense" and organization of their sentences and perhaps helping them reword.

c. Rereading a story aloud several times as writing is being done.

4. Tell the students to repeat the process above using their own worksheet and different articles and pictures.

FROM PICTURE TO STORY

PROCEDURE:

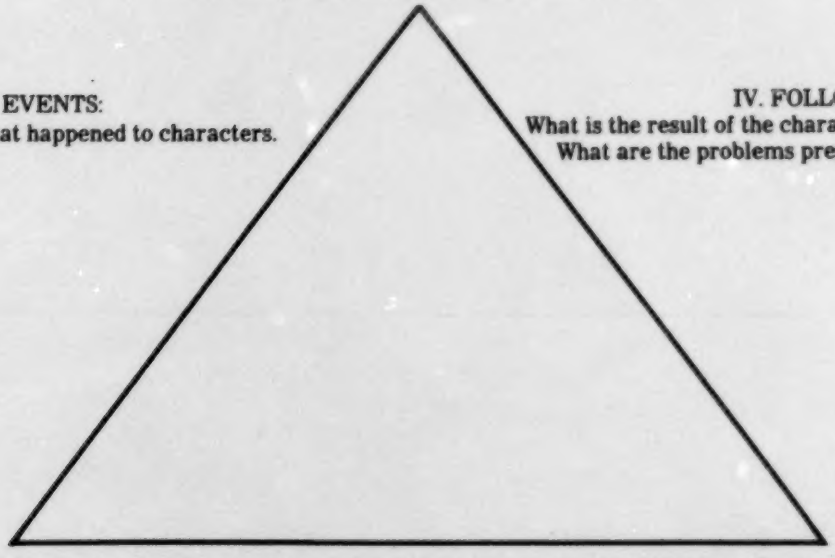
1. Select one or two pictures and two or three articles that are related, or use the class-selected pictures.
2. List below all the words that come to mind when you look at the pictures.
3. Decide what type of story you would like to write (funny, scary, serious — others)
4. Finish worksheet 1, filling in the blanks with the important parts of your study.
5. Write the story.

BASIC STORY FORMAT:

III. CLIMAX: — How is the problem solved? What decisions do the characters make concerning their problems(s)?

II. BUILD UP EVENTS:
Describe what happened to characters.

IV. FOLLOW THROUGH:
What is the result of the character's decision?
What are the problems presented to them?



I. INTRODUCTION: Should introduce setting, characters, time.

V. CONCLUSION: — Final event in the story (i.e. good guy and girl ride off into the sunset.)

This sheet could be reproduced twice to use first during the introductory class exercise, then for the individual story-writing exercise.

NAME: _____ DATE: _____

FROM PICTURE TO STORY

PROCEDURE:

1. Select one or two pictures and two or three articles that are related, or use the class-selected pictures.
2. List below all the words that come to mind when you look at the pictures.
3. Decide what type of story you would like to write (funny, scary, serious — others)
4. Finish worksheet 1, filling in the blanks with the important parts of your study.
5. Write the story.

BASIC STORY FORMAT:

III. CLIMAX: — How is the problem solved? What decisions do the characters make concerning their problems(s)?

_____

_____

_____

II. BUILD UP EVENTS:
Describe what happened to characters.

_____

_____

_____

_____

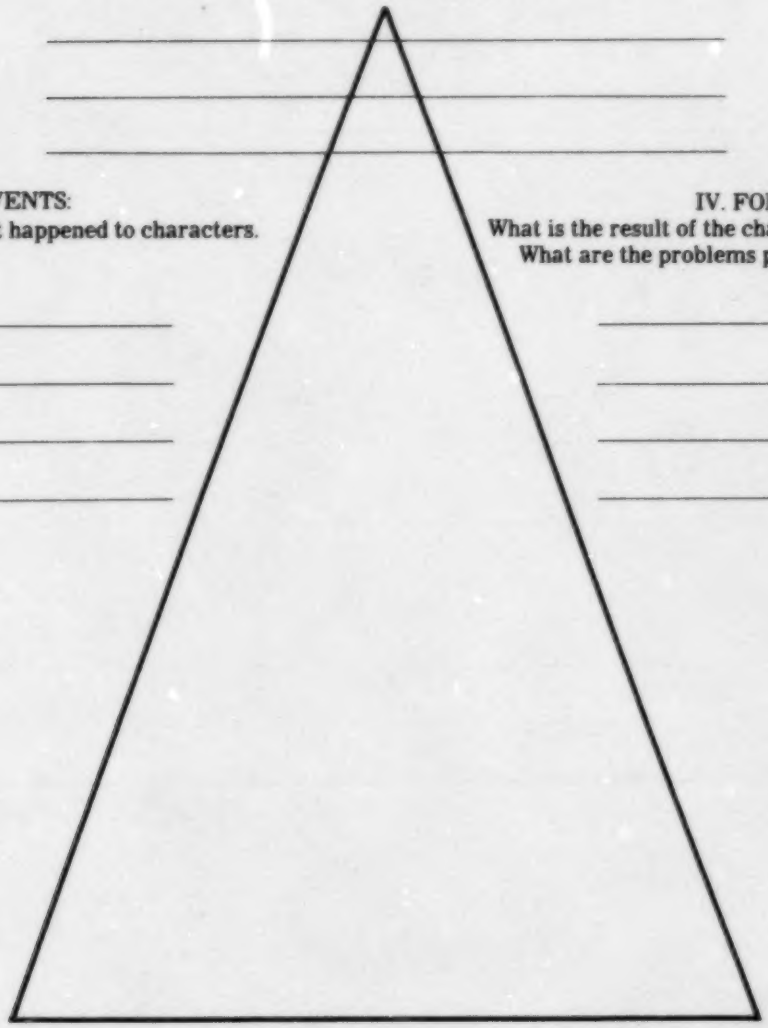
IV. FOLLOW THROUGH:
What is the result of the character's decision? What are the problems presented to them?

_____

_____

_____

_____



I. INTRODUCTION: Should introduce setting, characters, time.

_____

_____

_____

_____

V. CONCLUSION: — Final event in the story (i.e. good guy and girl ride off into the sunset.)

_____

_____

_____

NAME: _____ DATE: _____

EXTENDED ACTIVITY

1. Share your stories with the class.
2. Write and perform a monologue for one of your characters as your story climaxes.

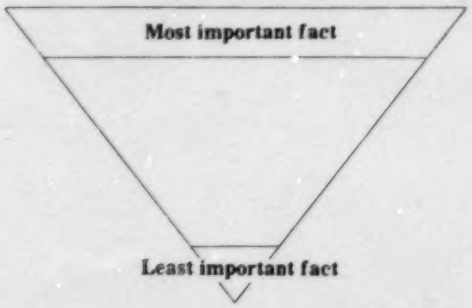
LEVEL INFORMATION: LA MS, HS

FEATURE STORY

OBJECTIVES:
The students will:
1. Differentiate between a feature story and other types of news stories.
2. Write a feature story with introduction, body and conclusion.
3. Recognize the five Ws and H in a feature story.

TEACHER BACKGROUND:
Feature stories differ from news stories in focus. Feature articles include:
a. Human interest stories.
b. Articles connected to a straight news item.
c. Special information articles and regular columns.
d. Articles with potential reader interest but not of immediate news importance.
e. Feature articles can be in any style of writing the author prefers, but it will have an introduction, a body, and a conclusion. It will be written in short paragraphs, and it will contain the five Ws and the H. The feature story does not necessarily follow the inverted pyramid form of a straight news story. News stories include:
a. Straight news written in an inverted pyramid style.

inverted pyramid style of
straight news story



b. All the important facts of the story — who, what, when, where and how — in the first, or lead, paragraph.

TEACHING SUGGESTIONS:
1. Each of the activities emphasizes a different aspect of journalistic writing.
2. Help the students complete activities I and II.
3. When activities I and II are complete, ask the students to read "Ash Army" on Page 25 and "Steamy peak . . ." on Page 10.
4. Conduct a discussion about what differentiates the feature article ("Ash Army") from the straight news article ("Steamy Peak"). They should be able to discriminate with criteria similar to those mentioned in the teacher background section above.

ACTIVITY I — FEATURE STORY

REFERENCE ARTICLES:
— "Pregnant part-poodle rescued . . .," Page 40
— ". . . Mom and pups OK," Page 40
— Photo, "Mother and children doing fine," Page 40
— "Couple struggle for life," Page 40

PROCEDURE:
1. Read the feature stories on Page 40 of "Mount St. Helens."
2. List the "how" or "when" words from one of the article below.

Answers will var

3. List the "what" words from the same article.

Answers will vary

4. In the feature stories you just read, what did the people featured have in common? How were they different?

Answers will vary

5. Why do you think these people were chosen for a feature article?

Answers will vary

205

PROCEDURE:

1. Copy three headlines from pages 23-27 of "Mount St. Helens."

   a.

   b.

   c.

2. Could you infer what each story was about by reading the headline?

Students should answer "yes."

3. Why do news stories have headlines?

To tell main idea of articles and attract attention.

4. Write an original headline for one of the stories emphasizing the following:

   "Who:"

   "What:"

   "When:"

   "Where"

   "Why"

Answers will vary.

5. What type of verb appears in most headlines?

Active

6. Where do the facts for a headline usually originate?

In the lead paragraph.

ACTIVITY III — WRITING A FEATURE STORY

1. Put yourself in the role of interviewers. Choose one person from "Mount St. Helens" — a mudflow or ashfall victim — to interview. Make a list of questions you would ask that person. Be sure questions deal with the 5 Ws and How.

Answers will very, but include 5 Ws and H.

2. Pick a "hard news" story from the "Mount St. Helens" tabloid. Invent a feature story from its ideas. Be sure to include a headline, introduction, body and conclusion.

Stories will vary but include headline, introduction, body and conclusion.

NAME: _____ DATE: _____

FEATURE STORY — ACTIVITY I

REFERENCE ARTICLES:
- "Pregnant part-poodle rescued . . .," Page 40
- ". . . Mom and pups OK," Page 40
- Photo, "Mother and children doing fine," Page 40
- "Couple struggle for life," Page 40

PROCEDURE:

1. Read the feature stories on Page 40 of "Mount St. Helens."

2. List below the "how" or "when" words from one of the articles.

3. List the "what" words from the same article.

4. In the stories you just read, what did the people featured have in common? How were they different?

5. Why do you think these people were chosen for a feature article?

NAME: _____ DATE: _____

FEATURE STORY — ACTIVITY II

PROCEDURE:

1. Copy three headlines from pages 23-27 of "Mount St. Helens."

   a.

   b.

   c.

2. Could you infer what each story was about by reading the headline?

3. Why do news stories have headlines?

4. Write an original headline for one of the stories emphasizing the following:

   "Who:"

   "What:"

   "When:"

   "Where"

   "Why"

5. What type of verb appears in most headlines?

6. Where do the facts for a headline usually originate?

NAME: _____ DATE: _____

ACTIVITY III — WRITING A FEATURE STORY

1. Put yourself in the role of an interviewer. Choose one person from "Mount St. Helens" — a mudflow or ashfall victim — to interview. Make a list of questions you would ask that person. Be sure questions deal with the 5 Ws and How.

2. Pick a "hard news" story from the tabloid. Invent a feature story from its ideas. Be sure to include a headline, introduction, body and conclusion.

LEVEL INFORMATION: LA MS

EDITORIAL RESPONSE

OBJECTIVE:

The students will write a letter responding to an editorial or letter to the editor.

TEACHING SUGGESTIONS:

1. Tell the students to read the articles.
2. Discuss the points made by the articles with the class.
3. Brainstorm several points of view related to the articles.
4. Tell the students to select one of the articles and write a reply. Emphasize the response should be in first person (review if necessary).

EDITORIAL RESPONSE

REFERENCE ARTICLES:

— "Will goddess stay angry? Time will tell," Page 5
— "Dust driving longtime Cougar residents out," Page 21
— Editorial: "St. Helens viewpoint needed," Page 25
— "Effort confused at times," Page 33
— Spirit Lake Always, p. 39
— "No place like home," Page 44

PROCEDURE:

1. Read the reference articles in "Mount St. Helens."
2. Participate in a class discussion about the articles and other possible points of view.
3. Write a letter replying to one of the articles. Write your letter in first person.

TEACHER BACKGROUND: WRITING A BUSINESS LETTER:

The following is a suggested form for a business letter. Each part is defined at the left.

Heading: Writer's complete address and the date. Commas are needed only between city and state, and the day of the month and the year.

Inside address: Complete name and address of person or organization you are writing to.

Salutation: In a business letter, the salutation is followed by a colon. You may address the letter to an individual when you know their name, otherwise address by title.

Body: State what you want to say in a brief, clear and complete manner. Be neat.

Closing: Only the first word is capitalized.

Signature: Even on a typed letter, your name should be written in.

8240 N.E. 72nd St.
Vancouver, Wash. 98663
August 16, 1980

Crater Parts Company
44 Oval Circle
Round Place, Washington 98808

Dear Sir:

Please send me, by parcel post, the following items as mentioned in your advertisement.

1 bottle of volcanic ash
2 Mount St. Helens T-shirts

I am enclosing a money order for $3.75, plus $.50 to cover postage, a total of $4.25.

Yours truly,

Harold M. Ogle

LEVEL INFORMATION: LA, SS MS, HS

TAKE A STAND!

OBJECTIVE:
The students will take a stand and defend it accurately.

TEACHING SUGGESTIONS:
1. Tell the students to read the reference articles in "Mount St. Helens."
2. Discuss advocacy with the students. Include as many illustrations of well-supported advocacy as you can. Include examples of editorials in the discussion.
3. Guide the students in their selection of a question on which they want to defend their position (See activity sheet for questions).
4. Tell the students to write their paper in an editorial format. Review editorial format as needed.
5. Form small groups by asking students who wrote papers on the same question to join for a discussion. Tell them to share their papers, identifying and discussing differences and similarities in their positions.

TAKE A STAND!

REFERENCE ARTICLES
— 'Copter jumps gun, — Harry stays put," Page 38
— "Two face charges following rescue," Page 43
— "FAA patrols sky near peak," Page 43
— "Lessons learned," Page 36.

PROCEDURE:
1. Read the reference articles in "Mount St. Helens."
2. Participate in class discussion about taking and defending a position regarding an issue. This is called "advocacy."
3. Select one of the following questions about which you have a position you are prepared to defend:
   a. Should government agencies have closed the area around Mount St. Helens?
   b. Should government agencies have enforced the Mount St. Helens closed area more strictly than they did?
   c. Should people have been allowed into the closed area at their own risk?
   c. Should planes be allowed to fly over the Mount St. Helens crater?
   d. Should Harry Truman have been forced to leave his lodge?
4. Write a paper defending your position regarding the question you selected.
5. Participate in a discussion of your position paper with others who took a position on the same question.

NAME: _____ DATE: _____

TAKE A STAND!

REFERENCE ARTICLES
- " 'Copter jumps gun, Harry stays put," Page 38
- "Two face charges following rescue," Page 43
- "FAA patrols sky near peak," Page 43
- "Lessons learned," Page 36.

PROCEDURE:

1. Read the reference articles in "Mount St. Helens."

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   a. Should government agencies have closed the area around Mount St. Helens?
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   c. Should people have been allowed into the closed area at their own risk?
   c. Should planes be allowed to fly over the Mount St. Helens crater?
   d. Should Harry Truman have been forced to leave his lodge?

4. Write a paper defending your position regarding the question you selected.

5. Participate in a discussion of your position paper with others who took a position on the same question.

LEVEL INFORMATION: LA, SS MS, HS

"IT'S YOUR OPINION THAT . . ."

OBJECTIVE:
The students will analyze an editorial or other opinionated personal writing.

TEACHER BACKGROUND:
Editorials can be read analytically with the reader asking:
1. Is the editorial written in language everyone can understand, or is it written for a group of people with specialized knowledge?
2. Is the editorial filled with long, hard words that make it difficult for the average person to understand, or is the language designed to fit the needs of a particular group.
3. Is the editorial based on fact, even though it presents an opinion?

TEACHING SUGGESTIONS:
1. Help the students find one or two articles in the Student Tabloid that reveal the opinions of the writer.
2. Tell the students to underscore the sentences in the articles that contain the writer's opinion.
3. Tell them to analyze the sentences they have underscored according to the following criteria:
   a. Editorials must be written in a language everyone can understand, not in a specialized language only a few can understand.
   b. Editorials must be based on fact, even though they represent an opinion.

"IT'S YOUR OPINION THAT . . ."

REFERENCE ARTICLES:
— Selected by the students

PROCEDURE:
1. Select one or two articles from "Mount St. Helens" that reveal the opinion of the writer.

A viewpoint is needed.

2. Copy the sentences in the articles that contain the writer's opinions.

Answers will vary.

3. Analyze the articles by applying the following guidelines:
   a. Everyone needs to understand the language; not just a few people with special knowledge.
   b. The words must be easily understood; there should not be many long, hard words that are not explained.
   c. The article should be based on facts, even though the writer has an opinion about those facts.

4. Participate in a class discussion of your analysis.
   a. Be prepared to give reasons for your analysis.
   b. Editorial language must contain words easily understood by the people who read the articles. They should not be filled with long, hard words difficult for the average person to read.
   c. Editorials should be based on fact, even though they represent an opinion.

Discuss the analyses the students have made. Emphasize the three criteria they have applied to their analyses.

NAME: _____ DATE: _____

"IT'S YOUR OPINION THAT . . ."

REFERENCE ARTICLES:
— Selected by the students

PROCEDURE:

1. Select one or two articles from "Mount St. Helens" that reveal the opinion of the writer.

2. Copy the sentences in the articles that contain the writer's opinions.

3. Analyze the articles by applying the following guidelines:
   a. Everyone needs to understand the language; not just a few people with special knowledge.
   b. The words must be easily understood; there should not be many long, hard words that are not explained.
   c. The article should be based on facts, even though the writer has an opinion about those facts.

4. Participate in a class discussion of your analysis.
   a. Be prepared to give reasons for your analysis.
   b. Editorial language must contain words easily understood by the people who read the articles. They should not be filled with long, hard words difficult for the average person to read.
   c. Editorials should be based on fact, even though they represent an opinion.

METRIC UNITS

To measure:	Name of unit	Symbol
Length	metre	m
mass (weight)	kilogram	kg

GREEK			LATIN		
decimal value	name	symbol	decimal value	name	symbol
$10^1 = 10$	deca	da	$10^{-1} = .1$	deci-	d
			$10^{-2} = .01$	centi-	c
$10^3 = 1{,}000$	kilo-	k	$10^{-3} = .001$	milli-	m
			10^{-4}	micro-	μ

LINEAR — THE METRE (m)

Use of metric prefix	
millimetre	0.001m = 1mm
centimetre	0.01m = 1cm
decimetre	0.1m = 1dm*
metre	1m = 1m
kilometre	1,000m = 1km

*(not commonly used)

MASS — THE GRAM (g)

milligram	0.001g = 1mg
centigram	0.01g = 1 cg*
decigram	0.1g = 1 dg*
gram	1g = 1g

*(not commonly used)

VOLUME — THE LITRE (l)

millilitre	0.001l = 1ml
centilitre	0.01l = 1cl
decilitre	0.1l = 1dl*
litre	1l = 1l

*(not commonly used)

CONVERSION FACTORS

U.S. customary to metric (approximate)

LENGTH:
1 inch = 25.4mm (exact)
1 foot = 304.8mm (exact)
1 yard = 0.9144m (exact)
1 mile = 1.609km

AREA:
1 square inch = 6.452cm²
1 square foot = 0.0929m²
1 square yard = 0.8361m²
1 square mile = 2.590km²

TEMPERATURE:
F.-32
1.8 = degrees Celsius

VOLUME:
1 cubic inch = 16.39cm³
1 cubic foot = 0.0283m³
1 cubic yard = 0.7646 m³
1 fluid ounce = 29.75ml
1 fluid quart = 0.946l
1 gallon = 3.785l

MASS:
1 ounce (av) = 28.35g
1 pound (av) = 0.4536kg
1 ton (2,000 lbs.) = 0.972t

VELOCITY:
1 mph = [0.447m/s or 1.609km/h]

*Adapted from Metric Measurement: A Handbook For Educators, State of Washington Superintendent of Public Instruction, Revised January 1978.

To convert English units to metric units, multiply by the conversion factor.

To convert metric to English units, divide by the conversion factor. Converting from metric to English units should be avoided. When making conversions, use the conversion factor as given and round the result, so it does not imply a greater degree of precision than existed in the original value.

EXAMPLE: To convert 7 inches to millimetres — 7 x 25.4 = 177.8mm rounded to 178mm or 180mm, depending on precision on original value.

APPENDIX II

TABLE 1, TOUTLE RIVER NEAR CASTLE ROCK

HISTORICAL DATE

	April 22 SW Run	May 21 11:30	May 21 17:30	May 27 SW Run	June 23 SW Run	Minimum Value	Mean Value	Maximum Value
Flow (cfs)363.00	2818.28							25,000.00
Temperature (Celsius)	9.0	11.4	13.8	10.0	15.6	1.20	9.95	21.20
Dissolved Oxygen (mg)	11.9			9.9	9.5	8.90	11.72	14.30
D.O. (percent saturation)	101.6			86.5	94.5	92.80	102.76	111.90
pH (S.U.)	7.5	7.5	6.2	7.4	7.7	6.40	7.30	7.90
Spec. Cond. (?mhos m)	36	295	290	290	150	29.00	54.60	112.00
COD (mg/l)		190	110					
Fecal Coliform (/100ml)	3	**	**	**	>800	1.00	8.77	130.00
Color	29			570	110	4.00	31.28	92.00
Turbidity (NTU's)	4	2500	2200	1600	260	1.00	10.97	220.00
Total Solids (mg/l)		10,000	8100					
TNVS (mg/l)		9700	7900					
TSS (mg/l)	7	9800	8200	7100	3100	2.00	32.65	480.00
TNVSS (mg/l)		9600	8000					
Unionized NH_3 percent	0.542	0.722		0.51		0.056	0.577	3.016
Unionized NH_3 (mg/1)	0.00	0.000		0.002		0.000	0.000	0.002
Total NH_3-N (mg/1)	0.03	0.03	0.03	0.43		0.00	0.05	0.37
NO_2-N (mg/1)		0.01	0.0			0.00	0.00	0.02
NO_3 O_2-N (mg/1)		0.05	0.06			0.01	0.12	0.40
NO_3 O_3N (MG/1)	0.19	0.06	0.06	0.01		0.01	0.08	5.40
O-PO_4-P (mg/1)0.01	0.02	0.05	0.02		0.00	0.01		0.06
T-PO_4-P (mg/1)	0.03	0.16	0.07	5.4		0.01	0.05	0.44
Total Alkalinity (mg/l as CACO3)		44.00	56.00			8.00	18.79	31.00
Diss.Cu (mg/1)		<10	<10			0.00	2.25	6.00
Diss.Cd (mg/1)		<10	<10					
Diss.Cr.(mg/1)		<10	<10					
Diss.Pb (mg/1)		<50	<50			0 0 0	7.96	19.00
Diss.Ni (mg/1)						0.00	12.42	130.00
Diss.Zn (mg/1)		<10	<10			0.00	12.42	130.00
Chloride as Cl		21.3	21.3			1.60	3.10	5.80
Soluble iron as Fe (mg)/1)		240	230					
Soluble Manganese as Mn		490	500					

Estimated
< Less than
> Greater than
* Based on data collected from 10/70 through 9/79
**Too much sediment

Data compiled by Anne Haines
Washington Department of Ecology

APPENDIX III
PLATE THEORY LINKS ST. HELENS, RED SEA, ANTARCTICA

By DOUGLAS GANTENBEIN

Though they are thousands of miles apart, Mount St. Helens, the Red Sea and coal deposits in Antarctica all have a great deal in common.

They all owe their origins — and in the case of St. Helens, present activity — to "plate tectonics," the geophysical law that daily changes the shape of our earth.

Plate tectonics emerged as the leading theory behind the formation of the continents during the 1960s, when a wealth of new information gave sudden meaning to long-time puzzles. Put simply, it says that the earth consists of large, rigid "plates" floating over the semi-molten mantle of the earth.

Plate tectonics accounts for the presence of tropical plant and amphibian fossils in icy Antarctica.

It also accounts for the jigsawlike appearance of parts of the earth. Anyone with a world map can see that South America and Africa and the land masses of Saudi Arabia and northeast Africa fit together too closely for mere coincidence.

The notion that continents were moving is not new, said Peter Misch, a University of Washington geologist. An Austrian geologist had theorized early this century that the Alps were the byproduct of a collision between Africa and Europe.

But this created a puzzle. If parts of the earth were colliding — with one likely sliding beneath another — from where did the material to replace it with come?

The answer came from marine geophysicists early in the 1960s with the discovery of sea-floor spreading.

This concept says that the mid-ocean ridges found in all of the major oceans of the world lie over enormous pools of molten material. As this hot material rises, it pushes earlier deposits to either side, widening the sea floor.

Hints that this might be occurring emerged around 1962, said a University of Oregon geology professor, Dr. Alexander McBirney.

McBirney said it was then the startling discovery was made about there being virtually no "old ocean crust — it all was millions of years younger than the surrounding continents.

It had been assumed the sea floor and the dry land masses were about the same age, and the two were created when a younger, hotter earth split up into lighter and heavier geologic masses.

At first controversial, the sea-floor spreading theory gained credence when phenomena called magnetic anomalies were discovered on either side of the midocean rifts.

As the rock material issues on to the sea floor, it adopts the magnetic polarity prevalent at the time. But for unknown reasons, the earth's magnetic field shifts at intervals of from 50,000 to 20 million years.

As the field shifts, the new rock assumes the polarity that then exists. The result is a series of magnetic bands of differing polarity that are symmetrical on each side of the midocean rift.

The mechanics of sea floor spreading began far before the earliest life on the planet — possibly as long as 3½ billion years ago said McBirney.

At that time, the earth's continents were part of a massive super-continent, commonly referred to as "Gondwanaland."

As the ocean floors began to expand, Gondwanaland was split up. South and North America broke free from Europe and Africa and moved across what is now the Atlantic Ocean. Antarctica moved southward — in the case of Antarctica from a tropical to a polar environment.

Sea floor spreading continues today between six identifiable major plates. It varies from one to eight centimetres (about 2 inches) annually.

At that rate, it would take about 200 million years to create the Pacific Ocean and about 150 million years to form the Atlantic.

In the Pacific area, sea floor spreading takes place along a line extending southward from the so-called Juan de Fuca ridge, located about 200 miles off the Oregon coast.

Interrupted in southern California — where the Pacific and American plates are moving laterally, not separating — the Pacific rift begins again just east of Mexico and conintues in an enormous arc across the Pacific, under Australia and into the Indian Ocean.

An obvious question is this: If the sea floors are expanding at the lightning-like (geologically speaking) rate of almost 2 inches a year, why does not the earth run out of room for all this new material?

The answer is the key to such events as the St. Helens eruption, said Peter Misch.

As the heavy sea floor material moves along the surface in a layer some 10 kilometres thick, it eventually collides with the thicker (50-70 kilometres), lighter continental plates. "Floating" as they are on the heavy basalt, the continental blocks are able to override the approaching sea floor crust, forcing it to bend and move beneath the continents.

The area where the sea floor crust plunges beneath the continents is called the subductive zone, Misch said. Around the Pacific Ocean, a subduction zone extends from the North American coast northward through the Aleutians and down through Japan.

It is this subduction zone that is responsible for the storied "Ring of Fire" around the Pacific. But although subduction zones and vulcanism clearly are associated, many of the details concerning the exact origin of volcanoes are not clear.

As the sinking crust moves deeper in the subduction zone, temperatures increase. However, pressure increases as well, raising the melting point of the rock. It is not clear Mirsch said, that this hot, nosediving sea-floor crust is the material that eventually is tossed out of volcanoes. Samples of lava from volcanoes simply do not connect the lava to the offshore sea floor.

What may be happening instead, he explained, is that water carried down with the sea floor material becomes superheated and rises. As it comes in contact with other rock materials, it lowers the melting point of that rock.

This newly melted rock, then, might be what becomes the magma that forms volcanoes.

The precise mechanics of magma formation also are unclear. As Misch said, "We're not able to climb down a hundred kilometres and look at the rocks."

But there is evidence of an "asthenosphere" of semi-molten rock that could be the birthplace of magma. Alexander McBirney said this zone corresponds with the intersection of the sinking sea plates and the zone of vulcanism in the Pacific Northwest.

The line of volcanoes in Oregon, Washington and northern California obviously relates to some point where the submerging sea crust becomes hot enough to either move up itself or force rock above it to melt and rise. As McBirney

said, "it's a matter of faith" that subduction and vulcanism are related.

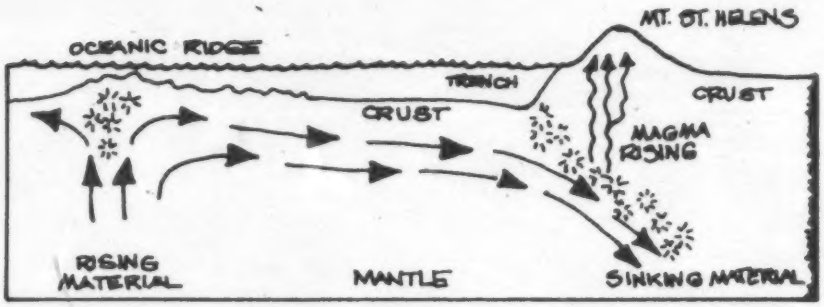
Even the manner in which magma is able to collect into amounts large enough to force its way to the surface is not entirely known.

"That's the $64 question," Misch said.

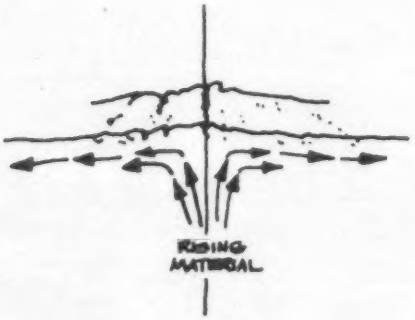
Apparently, the molten material collects and simply rises through the heavier, denser layers of the earth's mantle until it reaches cracks in the less plastic continental crust, from where it seeps to the earth's surface.

In most cases, the eventual result is a volcano. Sometimes, however, an enormous "bubble" of magma will come near the earth's surface but will not break through. Such magma domes, called batholiths, underlie parts of the North Cascade range in Washington.

THE COLUMBIAN, March 30, 1980



The Pacific Ocean, as it might look in profile as hot material rises through an oceanic ridge, or rift, then moves toward North America. As it sinks beneath the continent, the ocean crust is heated and apparently is at least indirectly related to volcanoes above it.



Cross-section of a midocean rift shows how rising material moves away from the rift. Dark and light bands are "magnetic anomalies."

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MOUNT ST. HELENS, MAY 18-19, 1980 — A SCENARIO

By MICHAEL A. KOROSEC

On Sunday morning, May 18, 1980, the climactic eruption of Mount St. Helens began. From U.S. Geological Survey news releases, media coverage, and eyewitness accounts, an attempt will be made to build a scenario of the events that took place in the vicinity of the volcano that day and the next. Relatively little information is available at the time, considering the magnitude of the explosive eruption and its devastation. As more facts and observations are collected and become available, it is likely that portions of this scenario will need to be changed.

At about 8:32 a.m. Sunday morning, a Richter magnitude 4.9 earthquake was recorded. Prior to the earthquake, the only visible activity on the mountain was very minor venting of steam from a fumarole at the bottom of the crater and from the small vent on the southeast rim of the crater. The earthquake triggered the collapse of ice blocks into the crater from glaciers on the south side. A few seconds later, a large portion of the north flank of the volcano began heaving and rippling, and slipped downslope towards the valley of the North Fork of the Toutle River along a fairly flat, steep detachment plane.

Many steam vents opened at the top of this detachment plane almost immediately, and either dust or steam was pushed out in front of the slide. As the downward movement of the slide exposed a deep portion of the slide plane, perhaps 1,000 feet in elevation below the top of the detachment surface, a cloud of dark-colored ash arose nearly vertically at first, but quickly spread laterally to the north. As the landslide continued to move downslope, the ash cloud grew very quickly as it was blasted about 25 to 40 degrees from vertical off toward the north. At the same time, a lateral blast was directed nearly due north through the upper portion of the slide block. Very shortly after, the summit crater erupted with a vertical blast of steam and ash. The vertical flank eruptive cloud was initially darker than the developing upper crater cloud, and the lateral blast which spread outward much more quickly than the others was the lightest in color.

The leading edge of the lateral blast raced ahead of the landslide, reaching the valley floor and traveling up and over the north valley walls. As it reached trees, the blast stripped their branches and needles. Stumps were left standing but again were partially buried by heavy ash fall. In the fringe areas, pine needles were either stripped from standing trees or singed orange in a zone about 100 to 300 meters beyond the fallen trees. The ash cover ranged from several feet to several inches out from the crater. A rapid transition from four inches to less than an inch over a distance of about ¼ mile occurred just beyond the zone of fallen trees on the far northwest corner of the devastated area.

Temperatures within the zone of devastation must have been quite high, estimated to have been between 200 and 300 degrees Celsius. Plastic on a blown-over truck camper 13 miles north-northeast of the volcano in the Ryan Lake area was melted. Similar occurrences have been reported for vehicles near Spud and Elk Mountain northwest of the volcano. Fishermen along the Green River in section 3 were burned badly, surviving only because they jumped into the river when it happened. The burns occurred as they came up for air and after they left the water. The heat evidently came upon them in a series of waves over a period of about 10 to 15 minutes.

After the lateral blast lost its hurricane force and high temperatures, the ash cloud slowed considerably, but continued to move to the northwest and northeast, reaching the town of Silverlake about 1.5 hours after the eruption. The cloud moved along the surface topography at an altitude of less than 1,000 feet, traveling about 20 to 30 miles per hour. It was this cloud which deposited significant amounts of the ash in the Mossyrock and Riffe Lake area, and much of the Morton ash.

The nuee ardente or ash cloud which rolled down the south side of the volcano was much smaller than the north side activity, descending not far beyond the slope break. No obvious destruction resulted from this nuee, though it probably did deposit at least a thin layer of hot ash on the south flank.

At the crater, dark ash clouds were shooting upward very rapidly, reaching elevations of 50 to 60 thousand feet within several minutes of the initial eruption. Rock fragments and pumice were carried upward along with the ash, raining out in a large area to the north and east, extending at least to the Blue Lake and Horseshoe Lake area, 25 to 30 miles away. The ash, of course, was carried well beyond this point.

Pyroclastic flows periodically poured out of the crater and down the north flank into the valley below. These flows probably occurred throughout the day, with a few reported to have occurred the next day. The early pyroclastic flows, along with the hot ash and debris began melting the snow and ice that remained on the flanks of the mountain and the broken glacial ice blocks within the valley. This water, along with ground water, possibly torrential rains from the eruption cloud, and water displaced from Spirit Lake, mixed with the ash and debris in the valley, creating small to very large mudflows which combined and began moving down the Toutle River valley very shortly after the eruption began. This process continued, to varying degrees, throughout the day. At some point, a large mudflow developed in the upper reaches of the South Fork of the Toutle River valley from the Toutle and Talus Glaciers. In addition, waters from the vicinity of Shoestring Glacier mixed with ash and debris, creating a mudflow which moved down the southeast flank and out the Pine Creek drainage, reaching the Swift Reservoir. Hot ash and pyroclastic flows which poured down the northeast flank and across the Plains of Abraham, melted the ice fields between the Nelson Glacier and Dogs Head. This created a very large mudflow which moved down the western drainages of Smith Creek,

continuing southeast along the main course of Smith Creek into the Muddy River and reaching the Swift Reservoir. These two east and southeast mudflows raised the level of Swift Reservoir by two feet.

During the course of the day, a large volume of material was removed from the south wall and the area between the central and lateral vents. At times, two distinct plumes could be seen rising from the crater, one directly over the central vent, the other centered nearly a mile due north, just south of the pre-eruption location of Goat Rocks. A large portion of this material may have been removed during the initial blast. There is no way of knowing how many individual pyroclastic flows and nuees ardentes descended the slopes of Mount St. Helens during the day and night. Some flows are reported to have traveled at speeds in excess of 70 miles per hour.

The vertical ash eruption had maintained levels of 50,000 to 60,000 feet for several hours after the initial eruption, but decreased by early afternoon to levels at times under 40,000 feet. By 4:30 p.m., the ash cloud had built back up to its highest level, about 63,000 feet, lasting for about an hour. This large vertical blast may have been accompanied by a lateral event on the north side, such as a large nuee ardente, because another low altitude ground-hugging ash cloud passed just east of Silver lake, at about 6:00 p.m., moving north at about 20 to 30 miles per hour. By evening, the height of the vertical eruption was only 15,000 feet, but occasionally reached 20,000 feet during short blasts. By Monday, eruptions consisted of ash erupting to only a couple of thousand feet above the crater.

Seismic activity consisted of an almost continuous series of low to moderate strength events during the initial phase of the eruption. Harmonic tremors were recorded throughout the day, starting out at shallow depths of 2 to 3 km and getting progressively deeper to about 10 km by day's end. Just before noon, seismic activity increased. This seems to correspond with a color change for the ash, from dark to light. The activity climaxed between 3:00 and 5:00 p.m., roughly corresponding to the second large vertical ash eruptions. After this period, however, activity dropped off considerably.

By Monday, with the eruptive activity on Mount St. Helens beginning to slacken, the topographic changes to the area around the volcano could be assessed. The once symmetrical 9,671-foot peak had been transformed into a U-shaped basic nearly 2 miles long from north to south and about 1 mile wide east to west. The rim reached a reported maximum elevation of about 8,400 feet, but portions of the rim were several hundred feet lower. The north flank opening to the crater is at about the 4,400-foot elevation. The Sugar Bowl and Dogs Head domes were preserved on the northeast side. Most of the glaciers are gone, but a few remained, at least in part, under a cover of ash. They possibly include Swift, Dryer, Talus, Toutle, Ape and Shoestring glaciers.

Within the crater, steam issued from numerous vents and fumeroles, concentrated on the south side over the central vent, with a few in the area of the exposed core of the Goat Rocks dome in the northern part of the crater basin. The crater bottom is about 300 feet below the north rim, and several thousand feet below the south rim.

The Swift Reservoir south of the volcano had its water level raised by about 2 feet, representing an influx of 13,000 acre-feet of debris from Pine Creek, Smith Creek and Muddy River.

The North Fork Valley of the Toutle River had been filled to a relatively flat surface, about 200 feet above the old valley floor. The material was a combination of ash flow, landslide material, large blocks explosively ejected from the volcano, and pyroclastic material. This valley filling extended down the valley to about Camp Baker and up some of the drainages such as Coldwater Canyon. Spirit Lake, which had been 185 feet deep, had its shoreline and drainage outlet raised by about 200 feet, and its shoreline extended about ¾ of a mile to the south. The depth had been reduced to about 80 to 100 feet, requiring a filling of 250 to 300 feet of debris.

Secondary activity within the valley resulting from cool waters contacting hot pyroclastic debris resulted in numerous steam eruptions and continuous fumarolic activity. A few large steam vents and many hundred fumaroles were still active two weeks after the eruption, and may continue to be active for years and possibly decades. Other features occurring in the debris-filled valley include kettle holes, where small to vary large blocks of ice melted out, leaving depressions measuring up to 50 feet in diameter; explosion craters, where buried ice and water were converted to steam in contact with hot pyroclastic debris and exploded upward through the sediment cover, "badland" and "scabland" topography, where water had eroded channels, sometimes 20 to 30 feet deep, and interconnected by a maze of smaller channels; small ripple and dune features, where water and(or) wind had piled or scoured ash; and large blocks of hydrothermally altered rock from the volcano's flanks, some over 50 feet high, looking like islands in a sea of mud and ash.

The May 18, 1980 eruption of Mount St. Helens was only one day in the history of a mountain that is thousands of years old, but that one day has left an important impact on the volcano and its surrounding area, and a lasting impression on all those who were a part of it.

WASHINGTON DEPARTMENT OF NATURAL RESOURCES
July, 1980

APPENDIX V

FACT SHEET

Gifford Pinchot National Forest
Pacific Northwest Region
500 West 12th Street
Vancouver, Wash. 98660
Mount St. Helens Geological Area
Volcano Information

FACT SHEET — July 10, 1980

BACKGROUND INfORMATION:

Location: 50 miles from Portland, Ore., in the Gifford Pinchot National Forest in the state of Washington.

Height: Summit elevation now approximately 8,400 feet. (Original height before eruption — 9,677 feet.)

Last Eruption: Last eruption from 1830s until 1857. Dormant for 123 years until March 27, 1980.

Other active volcanoes: First volcanic eruption in continental 48 states since Mt. Lassen in California last erupted in 1921.

CURRENT ACTIVITY:

Eruptions: From March 27 through May 17, 1980, consisted of steam and ash, with some small mud flows. On May 18, a violent explosion blasted away the northern portion of Mount St. Helens. The blast, accompanied by hot gasses, pumice, and ash devastated more than 150 square miles in a north and northwest direction from the mountain, with all trees and vegetation laid flat or killed. The largest ash cloud reached 63,000 feet and was tracked around the world. Ash fallout was heavy and crippled cities — Yakima, Washington, 85 miles away received 4 inches; Spokane, Washington, 255 miles — 1 inch; Pullman, Washington and Moscow Idaho, 260 miles — 2 inches.

On May 25 and June 12, two smaller eruptions, accompanied by some pyroclastic flows, left ⅛ — ½ inch of ash on Portland, Oregon and Vancouver, Washington, and southwestern Washington.

A dome of crusty volcanic magma has developed within the new crater. Currently the venting is mostly steam with occasional ash.

Fatalities: 28

Missing People: 36

Crater: May 18 eruption left crater approximately 1 mile wide and 2 miles long. An estimated one cubic mile of rock or 12 percent of the mountain was blasted away in the eruption. Elevation of mountain was reduced by 1,270 feet from 9,677 to approximately 8,400 feet. Landslides occur in the crater periodically.

Earthquakes: From March 22 through May 15 over 2,785 quakes of magnitude 3.0 or greater, of which 371 were over 4.0. Strongest to date: 5.1 on May 18. Earthquakes have subsided considerably since May 19, but vary with the degree of eruptive activity.

Floods: Mud flows and flooding caused extensive damage downstream from area.

The level of Spirit Lake was raised 150 feet by the mud flows, changing the shoreline. It has receded somewhat now.

Resource Losses:(Preliminary estimates) Twenty thousand acres of National Forest were devastated and another 200,000 acres heavily damaged or covered by 4 inches or more of ash. Resources destroyed: 1.6 billion board feet of timber; 100 miles of streams; 2,300 big game animals; 27 recreation sites; 63 miles of road; 12 bridges; 97 miles of trails; and 15 Forest Service buildings.

Total value lost: $134,987,000.

Potential Hazards: 1. Probable ash and steam eruptions.

2. Rapid moving flows of mud (melting snow and ice mixed with ash).

3. "Pyroclastic flows." These are masses of fiery gases and lighweight volcanic particles that skim like an avalanche along and above the ground at speeds of up to 100 miles per hour.

4. Ash fall carried by prevailing winds as a result of a major eruption.

5. Flooding.

CHRONOLOGY OF EVENTS:

- March 20: First earthquake reported. Earthquakes continued to build in number and magnitude.
- March 27: First eruption of steam and ash. This continued until April 18 when it stopped.
- April 18: 35,000 acres of Gifford Pinchot National Forest designated as Mount St. Helens Geological Area.
- May 7: Eruptions of steam and ash began again. Continued until May 14, when they stopped again.
- May 18: Big landslide and explosive eruption, accompanied by mud flows, large pyroclastic flows, flooding, and extensive ash deposit.
- May 25: Second substantial ash eruption with some pyroclastic flows.
- June 12: Third substantial ash eruption accompanied by pyroclastic flows.
- July 22: Fourth eruption, with less ash.

APPENDIX VI

EARTHQUAKE AND OTHER DATA FROM MT. ST. HELENS

DATE	A Average Number of earthquakes/Hr.	B Number of earthquakes greater than 4.0	C Largest earthquake in the 3-day period	OTHER INFORMATION
March 20,21,22	0+		4.1	
23,24,25	½		4.4	
26,27,28	5		4.9	First ash and steam eruptions
29,30,31	3½		4.6	First harmonic tremor
April 1,2,3	2½	2	4.9	Ash and steam to 20,000 feet
4,5,6	3	4	4.5	
7,8,9	2	4	4.7	Harmonic tremors occured in this 9-day period
10,11,12	1½	4	4.9	
13,14,15	1½	6	4.7	
16,17,18	1½	6	4.6	
19,20,21	2	7	4.8	No harmonic tremors
22,23,24	1½	9	4.6	Bulge detected
25,26,27	1	7	4.7	
28,29,30	1	7	4.7	No eruptive activities
May 1,2,3	1	6	4.7	
4,5,6	1	7	4.8	
7,8,9	1	9	5.0	Steam and ash eruption Harmonic tremor
10,11,12	½	10	5.0	No harmonic tremors
13,14,15	1	8	4.8	Decrease in eruptions
16,17	1	3	4.4	
18			5.1	Major eruption

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